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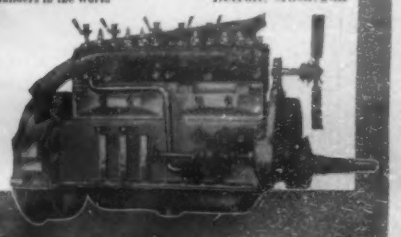

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Erecting the four-track, 1,000-foot span, steel arch over the East River, Hell Gate, New York.

Erecting the Largest Steel Arch Bridge in Existence

AN important feature in the costly improvements which have been carried through during the past few years by the Pennsylvania and New Haven railroad systems in and around New York is the building of a connecting railway for uniting the two systems by way of Long Island City. This connection is being made by means of a crossing of the East River, the most important feature of which is a four-track steel arch bridge (the longest in the world) with a clean span of 1,000 feet. This steel arch, which is now within measurable distance of completion, forms part of a steel viaduct, itself the largest of its type in the world. The whole length of the structure (arch and two approaches) from abutment on Long Island to abutment in the Bronx, is 17,000 feet, or considerably over three miles. With a wide sweeping curve, the viaduct passes over Hell Gate, Ward's Island, Little Hell Gate, Randall's Island, and the Bronx Kills. Not only is it the longest, but it is considerably the heaviest steel bridge in the world, over 80,000 tons of steel having been required for its construction.

The steel arch over the waters of Hell Gate, with its clear span between abutments of 1,000 feet, is made up of twenty-three panels, each measuring about 42½ feet between centers. The depth of the truss at each end is 140 feet; at the center 40 feet; and at the quarters 66 feet. The members of the great truss are of general box section. Their size is shown by the dimensions of the lower chord, rectangular in section, which is about 7 feet in width throughout, and varies in depth from 7½ feet at the crown to 10½ feet at the abutments. The total rise of the arch is 220 feet from the hinges to the crown of the chords. The weight of the structure is enormous, averaging 26 tons per linear foot throughout the span.

The method of construction is an interesting feature. The arch, as will be noticed from our illustration, is being built by overhang in two halves, which are carried out simultaneously from each main pier, the steel work being guyed back by massive temporary anchorages. These anchorages consist of a system of compression and tension members, made up of rectangular plate steel members, which, subsequently to the closing of the arch, will be used in the construction of the bridge. The compression members consist of a series of girders, buried out of sight in the ground back of the main towers, and extending from them to a heavy counterweight consisting of heavy girders loaded with a mass of earth. The diagonal tension members, extending from the counterweights to the top chords of the arch, are also formed of bridge material, which will ultimately be incorporated in the finished structure.

When the two halves of the arch meet at the center, this anchorage will be removed. Then the suspenders will be attached at their upper ends to the panel points of the arches and at their lower ends to the floor beams. The floor system will be built on the customary method of heavy cross girders and longitudinal stringers. The floor beams, by the way, are the heaviest ever built for a bridge, the section of the bottom flange of the girders at the center being 6¼ by 24 inches, making a total section of 150 square inches.

Wind bracing is carried in the plane of the upper and lower arches, from bearing to crown; but the main wind bracing is carried in the plane of the roadway, and it is arranged as a cantilever truss system. We are indebted to Gustav Lindenthal, the designer of the bridge, for assistance rendered in the preparation of this article.

The Second Pan-American Scientific Congress

OF interest to the educational world is the Scientific Congress that will convene in Washington, beginning December 27th, 1915, and concluding its sessions on January 8th, 1916. Through the co-operation of the Latin American countries, the second Pan-American Scientific Congress, held under the auspices of the United States Government through the Department of State, bids fair to be thus far the greatest Pan-American Congress. The first congress of this name was held in Santiago, Chile, in 1908. This congress was well attended by visiting delegates from the United States, and on its adjournment Washington was designated as the place of meeting of the second congress.

The Scientific Congress will discuss such main subjects as Anthropology; Astronomy, Meteorology, and Seismology; Conservation of Natural Resources, Agriculture, Irrigation, and Forestry; Education; Engineering; International Law, Public Law, and Jurisprudence; Mining and Metallurgy, Economic Geology, and Applied Chemistry; Public Health and Medical Science; Transportation, Commerce, Finance, and Taxation.

The significance of the congress is greatly enhanced through the international reputation of the persons chosen to arrange for the programme of the different sections of the congress, most of whom have an intimate first-hand acquaintance as well with the local resources, development and scientific interest in the various Latin American countries.

Birds of Passage and the War

THE war is having a great influence on the birds throughout Europe, especially on the birds of passage. Last autumn the storks left Russia and Galicia a month earlier than usual; they were noticed in flocks of thirty to a hundred on their way through Austria, where they alighted on the roofs and chimneys of the houses to rest before continuing their journey south.

Other birds of passage have deserted their old routes of flight and have chosen new air-roads along less disturbed regions. Both going and returning, these birds were observed in places where they were never seen before and were missed in the localities where battles were raging. In Luxemburg, where otherwise millions of birds congregate in the leafy forests, there are now scarcely any to be seen or heard. As an instance how the birds have deserted Luxemburg, a nature lover writes that "whole oat fields have sprung up along the roads and in the market squares of the little towns and villages where the horses have been fed as the cavalry passed through." This would never have been possible in other years, for then the birds would soon have pecked up every grain that fell to the ground.

The American Muskrat in Bohemia

ACCORDING to a report from the American Consul at Prague, the most dangerous animal pest in Bohemia is the American muskrat, which was introduced on the estates of Prince Colloredo-Mannsfeld in 1905, and has since spread over a region of one hundred miles radius from Dobrzisch, near Prague, where it was first liberated. The Consul says that "like the rabbit in Australia and the English sparrow in America, the muskrat has developed a long list of evil traits of which it is apparently innocent in its native habitat." It has been especially destructive in connection with the fish industries. The Agricultural Council of the Kingdom of Bohemia is waging a vigorous campaign against this troublesome invader.

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The Editor is always glad to receive for examination illustrated articles on subjects of timely interest. If the photographs are *sharp*, the articles *short*, and the facts *authentic*, the contribution will receive special attention. Accepted articles will be paid for at regular space rates.

The purpose of this journal is to record accurately, simply, and interestingly, the world's progress in scientific knowledge and industrial achievement.

A Warning from Plattsburg Camp

IT would defeat the purpose of the splendid movement represented by the business men's camp at Plattsburg, if the rapidity with which the regiment is being licked into shape should give the impression that the United States could extemporize a whole army with equal facility, and with the same rapid acquisition of efficiency as is being shown by the members of that camp.

For it must be remembered that the majority of the men are business men who, by virtue of their high intelligence, self-control and ability to co-operate with others, had already, before they came to the camp, acquired some of the principal elements in the make-up of an efficient soldier. It is these qualities of singleness of aim, intelligence, sense of discipline and willingness to submerge one's individuality in the mass, coupled with a very serious earnestness of purpose, that have enabled these men to fall so quickly into the habits and routine of the soldier's life.

Because these special men, who had already won out in the battle of life, have shown such quick proficiency in learning the soldier's duty and imbibing the military spirit, we must not make the mistake of supposing that raw recruits drawn from every walk of life—from farm and factory, from the store counter, from the clerical desk and from a dozen other vocations in life—could be hastily assembled and show an equally rapid facility in military drill, duty, and daily routine of life.

Great Britain at the opening of the war found herself in pretty much the same condition in which we stand to-day. Her new armies were volunteer armies, as ours would have to be; and the fact that the thorough-going soldier Kitchener has refused to consider sending these new troops for duty in the field until they have had about nine months of training, suggests that, at the very least, six months of similar training would be necessary for that new army of citizen soldiers which we should have to extemporize in case of threatened invasion.

The Plattsburg movement, like that represented by the students' camps, is intended to train a body of men who, in the event of hostilities, will furnish the forty thousand officers which will be necessary to lead the minimum army of defense which would insure the security of our country. Wonderful as their progress has been, it will take far more than this one month of training to render them competent to command.

There is no short cut from the raw recruit to the hardened soldier, competent to stand the superhuman strain of modern trench-line fighting.

A Stitch in Time Saves Nine

THE exploits of British submarines which have passed through the mine fields of the Dardanelles Straits and have torpedoed ships in the Sea of Marmorn, and even at Constantinople itself, prove that mine fields do not stop submarines. Heavy steel chain nets, however, do stop submarines, and the destruction or capture of over forty submarines of the German navy by the British during the past year of the war is due principally to this system of defense against the new mode of warfare. The Straits of Dover have been closed in this way from shore to shore, and the fact that for many months past not a vessel has been torpedoed in that stretch of the Channel reaching from the Straits of Dover to a line drawn from Portland Bill, near Weymouth, to Cape de la Hague, France, suggests that here also, over a distance of some sixty miles, netting has been used so successfully as to prevent the entrance of the undersea craft. In the early stages of the submarine war against merchant vessels ships were torpedoed not far from the mouth of the Mersey and elsewhere in the Irish Sea; but for several months past there has been a practical absence of losses from this cause in that stretch of the Irish Sea reaching from opposite the Mull of Kintyre, Scotland, down to a line drawn from Carnsore Point on the southeast coast of Ireland to St. David's Head on the opposite coast of Wales. The fact that the naval losses of late have taken place entirely outside of this zone suggests that the Irish Sea also has been effectively closed by similar means.

Two hundred feet is about the practical limit of depth at which a submarine can navigate, and it would be entirely practicable to build and sink huge chain nets of this depth, supporting them from a line of buoys at the top and anchoring them both at the top and bottom edge, so that they would not be moved by the tide. We understand that openings, known only to the Admiralty, are provided in the nets which are capable of being swung open, pretty much as a section of a bridge of boats is swung around for the passage of merchant and other ships. The location of these openings is constantly changed, so that they cannot be known to the enemy. It is not necessary that the supporting buoys shall float at the surface. The anchorage cables may be so adjusted that the buoys float a few feet below the surface; and by this means absolute invisibility may be secured and the position of the nets rendered impossible of discovery by the enemy U-boats, which, being completely blind when they are submerged, are liable to run into the nets, become entangled and so rendered subject to capture or complete disablement.

For defense of the narrow entrances to harbors against unheralded attack by submarines, the steel chain net is ideal. Therefore we would suggest that, in view of the present very serious diplomatic situation, prudence and foresight would suggest that our naval and coast defense authorities would do well to set about the manufacture of some of these nets at once, and proceed to gain the necessary experience in placing, anchoring, and operating them at the narrow entrances to some of our most important harbors on the Atlantic coast, and particularly across the entrance to the Panama Canal.

Thus, the Port of New York, in which is located the most important naval dockyard of the country, presents ideal conditions for experimental work of this kind. It is only about half a mile across the Narrows, which connects the upper with the lower bay, and it is not much more than a mile, we believe, from Fort Schuyler to Fort Totten at the easterly entrance to New York Harbor from the Sound.

A submarine requires about thirty feet of water in which to navigate if it is to be free from danger of striking bottom. Therefore, no great length of netting would be required to protect the entrances to Boston, with its navy yard; to Narragansett Bay, where our Atlantic fleet has its base in the summer; to the channel of the Delaware leading to the League Island yard; to the 500-foot channel leading to the entrance gates of the Gatun locks, and to the various other harbors and ports which our military authorities might wish to protect against surprise attack.

One of the most dangerous delusions under which the citizens of the United States, or a large proportion of them, labor is this: That the wide stretch of three or four thousand miles of ocean separating our Atlantic coast from Europe isolates us from the European war and forms a permanent and effective means of defense. As a matter of fact, the conditions are absolutely the reverse. The sea-keeping qualities and the high speed of modern ships of war, coupled with the baffling secrecy which belongs to the sea, render a long maritime coast such as ours more open to surprise attack than if our frontier was a land frontier running conterminous with that of a possible enemy.

To be convinced of this, look at the matter from the standpoint of submarine warfare. Modern wars are unheralded—the element of surprise is one of the most important factors upon which a vigilant and prepared enemy relies. A surprise attack by submarine offers itself, therefore, as a means by which a swift and paralyzing blow could be struck in the later days of those diplomatic exchanges which, according to a worn-out convention, should precede actual hostilities. Japan so struck at Russia when her torpedo boats dashed in the dark of the night into Port Arthur and struck a blow at Russia's maritime superiority from which she never recovered throughout the war.

The latest submarines have a cruising range at the surface of from three to five thousand miles, and should they fill their tanks, at starting, with oil fuel, another thousand miles or more could be added. Passing around the north coast of Ireland, a dozen or more of these craft, proceeding under their oil engines on the surface at economical speed, could reach the various harbors of our coast absolutely without detection. By day, if ships were sighted, the submarine would merely have to cut off its oil engines, turn on its motors and, with only periscope visible, creep quietly along below the surface until the ships had disappeared below the horizon. At night the craft could steam on the surface absolutely without fear of detection. Timing themselves to arrive off our coasts after sundown, they could proceed, driven by their silent motors, and therefore without the slightest sound to attract attention and without visibility, into the very heart of our harbors, where in the first gray dawn of the morning and in not many minutes' time, they could sink and destroy our ships before the latter had time to get ammunition in their guns to make any reply.

If you doubt these facts, gentle reader, inquire of the first naval officer that you meet or of any that you know, and he will tell you that the thing is perfectly possible.

Hence, we repeat that a useful autumn practice for our naval and coast-defense forces would be to lay down netting across our harbor entrances, and learn by experience the best way to operate it for the passage of such ships of the merchant marine and our Navy as may have occasion to pass through.

The War and Lumber

IF the present far-reaching conflict has been an incentive to the development and growth of certain American industries, stimulating them to a condition unprecedentedly above normal, there is one, and that the third greatest in the United States in number of employees, which cannot be said to have profited in any way by the European war. Neither in domestic prices, nor in local or foreign consumption of its products, has the status of the American lumber business assumed a healthier tone in the first year of the war.

In the twelve months preceding June, 1914, an average period, there was sent to Belgium, France, the United Kingdom, and Germany from ports of the United States 743,959,000 board feet of lumber, wood, and timber, hewn and sawed, to the value of $24,293,731. Those who have seen the great cargoes of American-grown forest products in process of being carried from the Hook of Holland up the Rhine and into Germany are aware of the importance that attached to this trade with the German States; at other European ports of entry it had also reached a high development. Within a year this became 391,448,000 feet, worth $10,041,441, the volume 52.6 per cent of what it had been, the value 41.3 per cent. There is now a complete cessation of the trade with Belgium and with Germany, and in the month of May, 1915, lumber, wood, and manufactured timber exported to the world had declined to a product worth 47 per cent of that for the same month one year before. It is interesting to see that Mexico is the one country to show an increased importation of wood and manufactured timber for the first half of 1915.

The statement has been made by competent authority that in normal times the export trade absorbs 10 per cent of our total timber cut. This trade is practically at a standstill, and the effect, acute abroad, is felt in various ways at home by a great industry which in the eight years past has known a period of unparalleled depression and too close competition. A representative lumberman and mill owner, whose interests are in the Middle West, Pacific coast, and South, believes that: "Conditions on the other side seem to govern the lumber industry here. Stocks of lumber held by the wholesale and retail traders are far below normal, and I believe it would take all the stocks in the hands of the manufacturers to-day to bring them up to the average. Though there is some volume of lumber moving at the present time, the sales price is so low that the manufacturer does not actually get back the cost of its production. I believe that with the termination of the war we will have four or five years' lumber business at prices which this country has never known before." Yet this capital is invested, and cannot remain idle, regardless of depression, low prices, and consequent waste in woods and mill.

Such conditions bear directly upon the future of a great resource. If normal trade conditions and equitable prices mark the culmination of the war, the effect must be to stabilize and bring about distinct improvement in our national forest policies, for the lumberman should be the forester in application. Conditions as they are necessitate a waste estimated at one third of the total cut, for the most part sound material, but of low grade, which the manufacturer cannot afford to market. Low stumpage and good forests, whether grown as a crop or held as an investment, are incompatible; inadequate returns and unrestricted competition in marketing the final product are ruinous to the conservation and perpetuation of the forest.

Science

An Elusive Wireless Station.—According to the London *Times*, the German authorities at Brussels have offered a reward of $2,500 for information as to the location of a wireless telegraph station supposed to be working in some private house in that city. For nine months it has furnished the people of Brussels with war news which the Germans desired to keep from them, and the search for it has hitherto been unsuccessful.

Bird Protection in the Dutch East Indies.—Dr. W. T. Hornaday, well known for his activity in behalf of wild-life protection in America, communicates to *Science* the gratifying news that measures have been taken by the Dutch authorities to prevent the extermination of birds of paradise in the Dutch East Indies. Shooting is now limited to three species, except in certain areas where the shooting of any bird of paradise is prohibited.

A Mountain Botanical Station in Jamaica.—A committee of the British Association for the Advancement of Science has leased from the government of Jamaica the botanical station at Cinchona in the Blue Mountains, and it is to be placed at the disposal of properly qualified persons who desire to make studies of tropical botany, for which the spot in question is especially suitable. Applications for the use of the station should be made to Prof. Bower, the University, Glasgow, Scotland.

Books as Carriers of Disease.—The last report of the Commissioner of Education undertakes to reassure persons who are fearful of the spread of disease through books by recording the results of a recent investigation at Yale University. During the cleaning of the library, a chemical analysis of the dust was made. About half of this was found to be mineral matter, while the other half was organic, including paper fiber, wood fiber, and molds. No mouth bacteria were found, and in general, the analysis showed the harmlessness of the dust.

Food Plants of the Gipsy Moth.—Mr. F. H. Mosher, in a recent professional paper of the U. S. Department of Agriculture, furnishes information that should be extremely helpful in the campaign against the gipsy moth. In reforesting infested areas and in planting trees (e. g., shade trees in cities) in regions to which the moth is likely to spread, it is obviously wise to select species for which this insect shows the least liking. Mr. Mosher gives the results of extensive laboratory and field experiments on the feeding habits of the gipsy moth, and classifies about 150 common trees and shrubs with respect to the degree of favor shown them by the larvæ. More than 60 species are definitely unfavored food for the larvæ of this pest.

A Sunday and Holiday Spring.—Is it not Izaak Walton who tells of a river in Palestine that never flowed on Sunday? A strictly veracious story to match this is told in a recent number of the *Proceedings* of the Connecticut Society of Civil Engineers by Mr. Robert E. Horton. It appears that in the red sandstone of the Passaic Valley there is a spring, located in a picnic ground, which formerly flowed perpetually. Its habits have changed, and it now flows only on Sundays and holidays. The mystery is easily explained: A number of artesian wells were bored into the sandstone in the vicinity of the spring to supply water to adjacent silk dyeing establishments. Except on Sundays and holidays, when the pumps are not running, the artesian slope is drawn below the level of the spring outlet and the spring ceases to flow.

Organized Scientific Research in Great Britain.—The British Board of Education has published particulars of a scheme for a permanent official organization of scientific and industrial research. It is proposed to form a committee of the Privy Council to be responsible for the expenditure of any new moneys provided by Parliament for scientific and industrial research, and a small advisory council, responsible to the above-mentioned committee and composed mainly of eminent scientific men and men actually engaged in industries dependent upon scientific research. The first members of the advisory council will be: Lord Rayleigh, Mr. G. T. Beilby, Mr. W. Duddell, Prof. B. Hopkinson, Prof. J. A. McClelland, Prof. R. Meldola, Mr. R. Threlfall, with Sir William S. McCormick as administrative chairman.

The Penguins of South Georgia are described in a very interesting and informing memoir by R. C. Murphy, just issued by the Museum of the Brooklyn Institute of Arts and Sciences. The writer's field work in this sub-Antarctic island extended from November, 1912, to March, 1913, thus including the greater part of the breeding season. During this time he acquired a rich store of information concerning the life histories of the local species—especially the king and johnny penguins—and would have gathered more but for the stupid vandalism of the crew of the sealing brig on which he made his voyage. This memoir is not only one of the most intimate pictures of penguin life that we have seen, but it also contradicts categorically a number of statements concerning these birds that appear in standard works on ornithology. It is fully illustrated with photographs. A curious discovery of the author was a penguin graveyard: viz, a pool of snow water on a mountain top, to which these strange birds retire to die.

Astronomy

The Royal Astronomical Society has just had its charter amended so that women are eligible for election as fellows and associates.

The Festival of the Sun.—The annual sun festival (*fête du soleil*) of the Astronomical Society of France, which has been held annually on the Eiffel Tower since 1904, on the evening of the summer solstice, was omitted this year on account of the war. Several Spanish members of the society, however, as well as other Spanish astronomers, held a sun festival of their own at the Fabra Observatory, in Barcelona, the director of which, Señor J. Comas Solá, is well known for his solar investigations. It is likely that this event will hereafter be celebrated annually at Barcelona, as well as at Paris.

The Observatory of Juvisy, which was founded more than thirty years ago by M. Camille Flammarion, is about to lose the character of a private institution and to be taken over by an association of astronomers and patrons of astronomy, who will ensure its perpetuation beyond the lifetime of the present owner. This change of proprietorship will, under French law, make it possible for the observatory to receive legacies. A unique undertaking of the Juvisy Observatory is the collection of observations from all parts of the world on the planet Mars, and the publication of a General Encyclopædia of Martian Observations, two volumes of which, covering the period 1636–1900, have already been published.

Telephone Time Service at the Sydney Observatory.—At Sydney, Australia, any telephone subscriber can now obtain correct standard time by calling up the Sydney Observatory. If he wishes merely to check his watch or clock, he asks for "Time," and is connected with an operator who reads off the correct time to the nearest half minute from a clock controlled by the standard clock of the observatory. If more accurate information is required, he asks for "Exact time," and is connected with a high frequency buzzer which transmits the actual beats of the observatory clock. This observatory had planned to inaugurate a wireless time service, but this undertaking has been postponed on account of the war. Sydney and Melbourne observatories have recently exchanged wireless longitude signals with each other and with several camps established by the government of South Australia—the first use of radio-telegraphy for this purpose in Australia.

The Solar Physics Observatory at Cambridge, England, to which place it was removed two years ago from a most unsuitable location in the midst of the smoke and fogs of London (South Kensington), has in addition to its observational work, been making a study of the areas and life-histories of sunspots from the Greenwich records for 1889–1901, and has also undertaken an examination of the heliocentric distribution of sunspots for the two cycles 1889–1901 and 1901–1912. The Cambridge spectrograms of Nova Geminorum No. 2 have been measured and discussed by Mr. F. J. M. Stratton, and most of the gaps in this series have been filled by material supplied by the Allegheny Observatory. The few dates not represented in either the Cambridge or the Allegheny series were filled by spectrograms sent from Bonn Observatory. Publication has been delayed by the war. The broad programme of work at this observatory includes the notable investigations of atmospheric electricity which have for some time been carried on by Mr. C. T. R. Wilson. A recent report on the work of the observatory notes, among other things, that "Mr. Wilson has succeeded in measuring the instantaneous changes of field resulting from distant lightning flashes, and in gaining information bearing on the quantity of electricity discharged in a flash."

A Year's Record of Meteor Observations forms the subject of a recent communication from Mrs. Fiammetta Wilson to the Royal Astronomical Society, and is worth quoting as an illustration of the interesting evenings that may reasonably be expected by anybody who takes up meteor observing as a hobby. During the year 1914, Mrs. Wilson observed 1,060 meteors in 450 hours of watching. The hourly rate would undoubtedly have been much higher if she had not maintained her observations at times of bright moonlight and nearly overcast sky. Whenever a few stars showed themselves, she considered the prospect sufficiently inviting to watch, and on such occasions she was so fortunate as to see some particularly brilliant meteors. Of the 1,060 meteors observed, 103 were above the first magnitude, very many were as bright as Jupiter, and several much brighter than Venus. The observer publishes detailed observations of the 103 brightest meteors. The colors were remarkably varied, including red, yellow, green, blue, white, etc. One is described as having a blue head and a yellow train. The movements were sometimes erratic. One "flashed out three times, each time as bright as Venus." Another had an "impeded movement, rather undulating." A third "broke off in middle of course, then went on again." And so on. Probably few persons who have not made a study of meteors realize how varied are these celestial fireworks.

Automobile

Detroit Factories Expand Rapidly.—America's automobile prosperity may be gaged from the statement that the twelve leading Detroit automobile companies are at present engaged in increasing their plants. The total amount of this increase is given at $5,000,000 cost, 850,000 square feet of floor space, with offering employment to 5,000 additional men. All these additions are for domestic production only, and have no connection whatever with so-called war orders.

Trailers for Ambulances.—Instead of continuing to convert passenger automobiles into ambulances, as in the beginning of the war, the British military authorities now use almost exclusively trailers, which are attached to the touring cars by means of ordinary drawbars. An anchorage for such trailers is attached to every touring car in military service, at very small expense, so that any one of the cars can instantly pick up an ambulance and convey it to the hospital at the rear. The trailer has been of great service to the hospital corps and is now manufactured in quantity by the inventor. The first car of this type was made in November last, and thoroughly tested before being submitted to the War Office.

Magnetic Trouble Lamp.—Trouble lamps have become an indispensable necessity to most motorists. But sometimes it is very hard to fix the "trouble lamp" in such a position as to throw the light on the point where the "trouble" is. Unless another person holds the lamp, the driver has to work with one hand—his other hand being kept busy supporting the trouble lamp. A new type of lamp has just appeared which at once does away with this difficulty. It is fitted with a "magnetic" base, enabling it to "stick" to any iron or steel part. The socket at the end of a ten-foot wire will fit any lamp socket on the car, while the base of the lamp itself can be stuck to any part of the motor or chassis, in any position desired, where it will remain until detached by switching off the light and removing it by hand.

Ten-cylinder Engines.—Aside from radial, rotating engines for aeroplanes, no internal combustion motors of ten cylinders have ever been designed. That there is no mechanical hindrance to a 10-cylinder engine, is the statement of a leading British manufacturer who speaks a good word for the 10-cylinder motor. The cylinders, five to each side, would be set in V-shape, at an angle of 72 degrees, instead of at 60 degrees in the 12-cylinder or 90 degrees in the 8-cylinder motor. It is more difficult and more expensive to manufacture a 5-throw crankshaft, but the manufacturer expects to balance this with the reduced cost of 10 cylinders as compared with 12. There appears a reluctance in Great Britain in accepting the American type of 8-cylinder motor as the *ne plus ultra* in automobile design, and a predilection for the 6 or the 12-cylinder engine.

A New Aluminium Solder.—Under the trade name Kaylon there is being introduced in Great Britain a new solder for aluminium, which is reported to have given excellent satisfaction. When soldering two aluminium surfaces with Kaylon, it is necessary to scrape away gently the thin oxidized skin on the outside of the metal, either with a knife or a fine rasp. The metal is then warmed in a flame, and the stick of Kaylon gently rubbed over the spot to be soldered. The metal should just be warm enough to melt the stick, but not hot enough to render it liquid. After the Kaylon is rubbed on, the surface is brushed with a stiff wire brush, making the solder combine well with the metal surface. The two pieces of metal are then held together and heat is applied until the solder forms a connecting skin. The chief advantage of Kaylon is said to be its permanency, due to its absolute indifference to influences of the atmosphere. The soldered joint will not oxidize, as nearly every other aluminium solder does. Its application in the automobile industry, because of the growing use of aluminium, renders this method of soldering of special interest to Americans.

The British Vanadium Tire Is Strong.—In their endeavor to fulfill the enormous demand for strong, practically puncture-proof tires from the war authorities, British tire manufacturers are bringing out several novel types of tires, in which the puncture-resisting qualities are greatly enhanced. One of the latest is the "Vanadium" tire. This consists of an exceptionally well-built tire, with two extra layers of fabric and two layers of small disks of vanadium steel. The steel disks, of course, greatly increase the resistance of the tire to puncture on the road, while a new "curing" process employed by this company is claimed to strengthen the rubber itself. The vulcanizing process is completed in two thirds of the time that had been possible before the invention of this method, and this reduction of the time of "curing" increases the tensile strength of the cotton fabric. When tires are cured too long, the fabric is impaired and its strength decreased. According to reports from Great Britain, this is a "British-built" tire, although American factories have been producing a very similar tire for some time past. The claim for "inventive thought" in this case may be merely imitation.

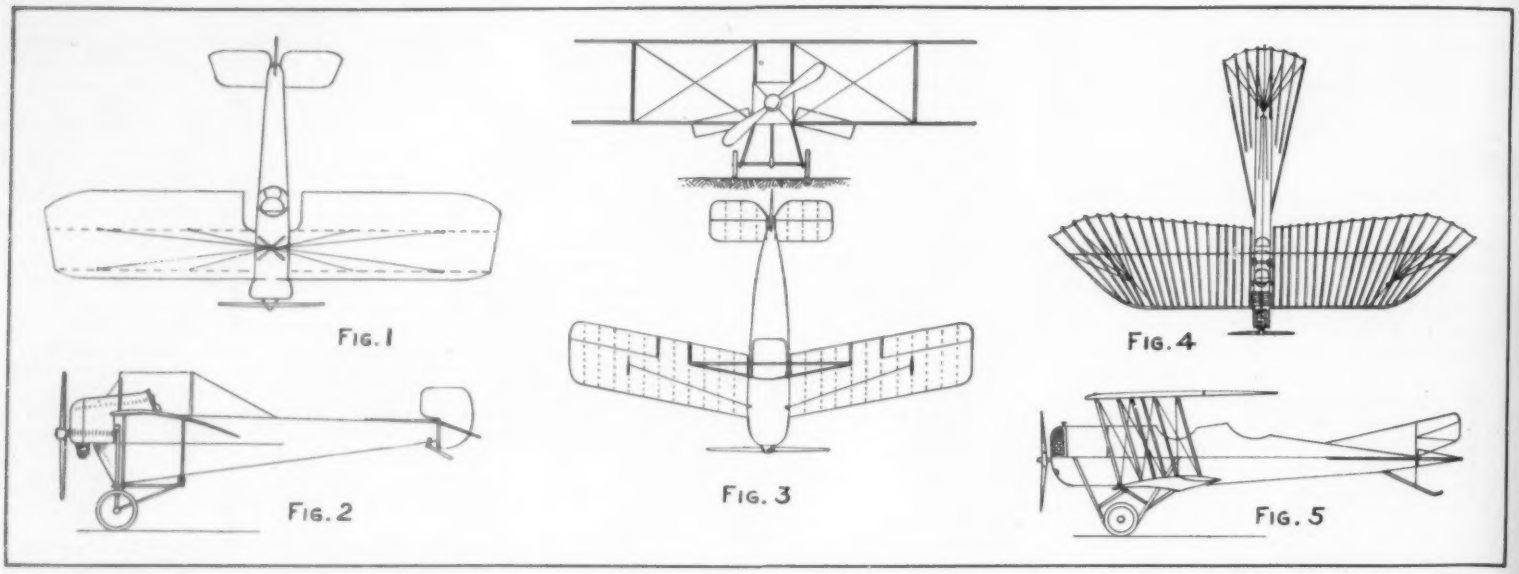

Fig. 1.—Clement-Bayard single-seater, whose wings are cut away to facilitate military observation. Fig. 2.—French R. E. P., whose stream-line body makes for speed. Fig. 3.—The British Tabloid biplane with raked planes, shown in plan and front elevation. Fig. 4.—German Rumpler Dove, whose pigeon-shaped wings make for stability. Fig. 5.—German D. F. W. Pfeilflieger with wings raked to provide a wide visual range.

Some rejected monoplanes and accepted biplanes of the warring nations.

How the War Has Modified the Aeroplane

The Passing of the Military Monoplane, and Development of the Battle-Biplane

By Ladislas d'Orcy

A RECENT dispatch from Paris stated that the Director of Military Aeronautics of France had decided to discontinue henceforth the purchase of monoplanes, their place to be filled entirely by fast tractor biplanes. Furthermore, such monoplanes that still are in flying condition shall be used only for training military pupils and shall see no more active service at the front.

This decision, which practically spells the death knell of the monoplane as a military instrument, has not come altogether unexpectedly. Since the beginning of the Great War a number of military airmen openly expressed their opinion about the small value of the monoplane for warfare. The principal arguments that were set forth in this connection were: 1. The monoplane's limited carrying capacity. 2. Its limited range of vision. 3. Its low range of speed.

The first argument was probably the least important, for monoplanes were used in France exclusively for gun spotting and tactical reconnaissances, for which purpose a fuel supply of three or four hours was found to be perfectly sufficient.

Indeed, if we except Garros' Morane-Saulnier single-seater, in which that celebrated airman succeeded in winging single-handedly several German machines, there is no instance where a monoplane was used in the French army for offensive purposes.

A 150 horse-power sea-going tractor of the German navy. The machine can be used for overland operations by exchanging the center float for wheels.

The second argument, limited range of vision, was a matter of much more concern. Indeed, for detecting concealed batteries and giving their correct range, as also for minor tactical reconnaissances, a fair visual range was a primordial requirement, which it was difficult to attain with the monoplane on account of the pilot's position back of the wings which put the observer's seat squarely amidst the wings and precluded a detailed inspection of the ground below.

Realizing this defect of the standard monoplane, the French Director of Military Aeronautics first tried to obviate it by discarding in January last the whole lot of monoplanes that were in commission—Blériot, Deperdussin, Nieuport and R. E. P. (Figs. 1 and 2)—and having them replaced by Morane-Saulnier "parasols," i. e., monoplanes on which the wings are placed above the fuselage, at about the same height as the top plane of a tractor biplane. Although this type of machine proved highly satisfactory as far as range of vision was concerned, its aerodynamic qualities were pronounced to be far below those of the ordinary type of monoplane, and this chiefly owing to the low center of gravity resulting from the altered position of the wings. This was especially noticeable when such machines were banked, which often resulted in a side slip; a striking example of this assertion is furnished by the accident that resulted in the death of Marc Pourpe, one of the most brilliant airmen of the Morane-Saulnier staff, who met his death near Rheims over the German lines through a side slip caused by a sharp turn.

But it was the third argument, low speed range, that probably caused the final decision—discarding entirely the monoplane in the French army. This default proved

Courtesy of *Flying*

Clear for action! Gunner's position on an armored Farman fighting scout.

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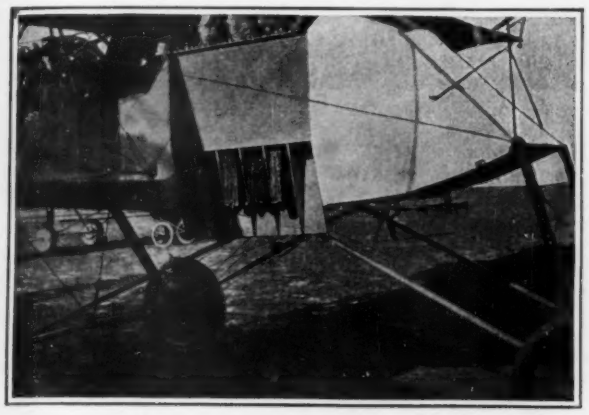
Side view in which is pictured a 70 horse-power Renault-engined BE-2c scout of the Royal Flying Corps.

indeed a very serious one. Low speed range, i. e., a small range between the flying and the landing speed of an aeroplane makes the latter practically worthless for military work of any description on account of the rough ground that makes up most of the so-called aeroplane bases near the front. For alighting on such a ground low speed is indispensable, unless every landing is to result in a partial distruction of the machine.

To attain the requisite of high speed range aeroplane constructors had to turn to the small tractor biplane, called Tabloid, which Sopwith in England was the first to develop. This type of machine possesses all the advantages of the monoplane without incorporating any of its drawbacks. (Fig. 3.)



Armored nacelle of a Voisin bombardier, showing the bomb-dropping device invented by Col. Espitallier. Voisin bombing squadrons have made most of the French air raids.

The Tabloid is just as handy and fast—if not more so—and almost as light as the monoplane, but its range of vision and its speed range are considerably better. A greater visual range is generally atained by "staggering" the planes, which consists in placing the top plane somewhat ahead of the bottom plane, and also in some instances by cutting away part of the bottom plane where it joins the fuselage. The Germans, however, attain the same results through another means, i. e., the planes are "raked," or swept back from the rectilinear so as to form an arrow head—a system that incidentally secures their machines a considerable inherent stability.

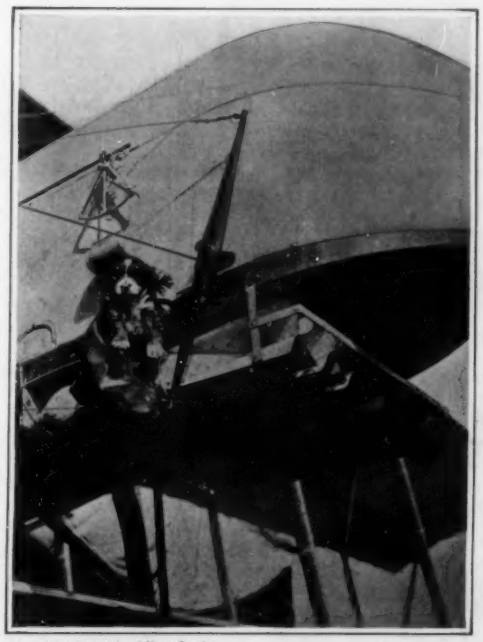
As to high-speed range, this is effected on the Tabloids by a disposition simple enough, but which it is impossible to incorporate in monoplanes; it consists in giving the top plane a large incidence (up to 5 degrees) and setting the bottom plane at a very small angle (one or two degrees only). This system works then as follows: for attaining the maximum speed the airman decreases the angle of his top plane so as to cut down the head resistance to a minimum, and by doing this he has obviously flattened out his bottom plane to 0 or even to a negative incidence; while for landing, when the minimum speed is required, he "stalls" the machine in order to produce the largest angle of attack and thereby the greatest head resistance, and in this case both planes will act as a brake, the incidence of the plane being set to about four degrees. Obviously the same condition exists at the moment when the machine takes the air, only in this case the great angle of attack is used for lifting at low speed.

Thus the Tabloid biplane solves all the problems that for so long have proven the stumbling block in monoplane construction. It is, therefore, not astonishing at all that the most noted monoplane constructors of France are now all adopting the Tabloid. Thus the Nieuport Tabloid has already been adopted by the French Aviation Service, while experiments with similar machines are being conducted by the Blériot, Deperdussin and Morane-Saulnier works.

Such is the radical development of the aeroplane on account of the Great War. How far this forcible change in the constitution of France's aerial fleet affects this nation's aeroplane industry can readily be gathered from the fact that at the outbreak of the war three fifths of the 749 aeroplanes belonging to the French army were monoplanes, the gradual weeding out of which resulted in their being replaced by Morane-Saulnier "parasols." Now the latest decree of the French Aviation Service practically puts on the scrap heap over three hundred machines not more than six months old, which will have to be replaced by an equal number of Tabloids, and this means for the French aeroplane industry an order of $1,500,000 for the development of a new type of machine—a sum which, no doubt, will be instrumental in further advancing the science of aeronautics.

In Germany conditions have been very similar to those above described. At the beginning of the war the Fatherland possessed between 700 and 800 monoplanes called Tauben (Doves), a name that comes from the pigeon-shaped wings of these machines. Having chiefly in view facility of construction the German Air Service, with its characteristic thoroughness, had since 1912 practically standardized this type by issuing orders that all the army monoplanes must be of the Dove type. Later it was decided to build the monoplanes of steel, and the government hastened forward the construction of steel Doves by all the factories that had produced successful monoplanes. These were the Albatross, the Jeannin, the Luftfahrzeug (L. F. G.) and the Rumpler Works of Berlin-Johannistal, the Wagon Works of Gotha, the Deutsche Flugzeug Werke of Leipzig (D. F. W.) and Kondor Works of Essen. (Fig. 4.)

Thanks to their pigeon-shaped wings, the Doves possess considerable inherent stability, which makes them particularly desirable for military work; their chief drawback is the heaviness resulting from the all-steel construction and the relatively heavy water-cooled engine employed. This disadvantage makes the operation of the Doves a very delicate one when near the ground, and necessitates a starting and landing place of considerable area, a requirement which it is difficult to conciliate with operations in the field. Furthermore, the Doves are badly designed for dropping bombs—a work they were supposed to perform—as both pilot and observer can only see ahead and not directly below; finally, on account of the tractor air-



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Bomb dropping device of a French Farman bombing aeroplane.

screw it was found impossible to arm Doves with a gun firing ahead, which is the logical position of armament for the attack of enemy aircraft—for this was another task the Doves were intrusted with.

When all these drawbacks, in addition to those mentioned in connection with French monoplanes, became apparent, the German Air Service decided in its turn to discard the famous Doves and to replace them by tractor biplanes, of which only about 100 were in commission at the outbreak of the war. Like the Doves, these machines were standardized into a uniform type, called Pfeilflieger (arrow-flyer), which means that their planes were "raked" so as to form an arrow-head. They were built by the following firms: A. E. G., Ago, Albatross, Aviatik, D. F. W., Euler, L. F. G., L. V. G. and Otto. (Fig. 5.) Now most of these firms build in addition to their standard biplanes, machines of a reduced type, which strongly resemble the Tabloids described above and are called Falken (falcons). Just like the Allies, the Germans use these machines for gun-spotting and tactical reconnaissances. Thus the Great War has practically united the contending tendencies of the French and the Germans by eliminating both the flimsy monoplane and the heavy Dove, and making both adopt the highly efficient tractor biplane, which, by the way, is a decidedly British product.

Perhaps the biggest surprise brought about by the Great War has been the notable success attending the use of the aeroplane for offensive operations, either for attacking enemy scouts or for bombing army depots, railway junctions, ammunition and aircraft plants *et simili*. This was made possible by the gradual development of two novel types of machines, the fighting scout and the bombardier.

When the war began, no European government had yet made up its mind as to which type of aeroplane was particularly suited for these purposes; many military experts even held the opinion that owing to its limited carrying capacity and the sensitive gun platform afforded, the aeroplane would not prove at all practical for this task. It is true, both the French and the German governments were at that time conducting experiments in order to ascertain the value of armor plating and the exactitude of bomb dropping devices, and endeavored to solve the tangled problem of providing the aeroplane with a proper gun platform. But these experiments were merely sporadic attempts at solving the problem of the battle aeroplane.

The first few months of the war radically upset all preconceived opinions about the value and the possibilities of the aeroplane. It was rapidly becoming evident that all the warring nations were lacking a type of aeroplane that would both scout and clear the skies of the enemy scouts, for both sides were carrying out reconnaissances without meeting serious opposition in the air, the watchword being generally to get back information and decline battle. When this deficiency was realized, the various aeronautical services hastened to remedy it by arming their large aeroplanes with machine guns, while pilots of fast scouts were equipped with automatics and carbines. This improvised armament soon proved inadequate for the set purpose, although a number of aerial duels ended with the defeat and retreat, or even with the destruction of one of the antagonists. But here it should be noted that destruction, when brought about, was generally caused by the setting on fire of the fuel tank or by disabling the pilot, but only very seldom by destroying a vital organ of the machine, against which rifle and even machine gun fire proved singularly inefficient.

In this game British and French airmen generally had the better of their foes, the British chiefly owing to their light and fast tractors which would easily out-fly and out-fight the heavy and sluggish Tauben of the Germans, while the French proved superior on account of their pusher biplanes armed with a machine gun firing ahead, which the Teutons could oppose only with tractors firing broadsides and astern. Their difference in armament soon manifested itself as a great drawback for the Germans who, being unable to make frontal attacks, were also too sluggish to out-fly their foes, while it greatly accounted for the aerial ascendency, both moral and material, attained by the French in the latter period of the war, for it is an old axiom that weapons of offense impart the spirit of offense, whereas the latter is impossible without the former.

These fighting scouts of the French were, in the first four months of the war the 80 horse-power Gnôme driven Farman and Voisin pusher biplanes, which carry a crew of two (pilot and gunner) and have a cruising radius of four hours when fully equipped. The armament consists of an air-cooled Hotchkiss machine-gun firing 500 rounds per minute. The Voisin pusher carried originally an armor belt around the nacelle; this was subsequently removed in order to reduce the total weight and obtain thereby a quicker getaway and more climbing ability.

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Armored nacelle of a French 135 horse-power engined Bréguet-Voisin bombing aeroplane, mounting a Lewis aircraft gun.

How successful these fighting aeroplanes have proven in clearing the skies of enemy scouts is borne out by a record compiled by a well-known aeronautical writer now serving with the French Aviation Corps, regarding

(Concluded on page 221.)

Strategic Moves of the War—August 25th, 1915

By Capt. Matthew E. Hanna, Recently of the General Staff, U. S. A.

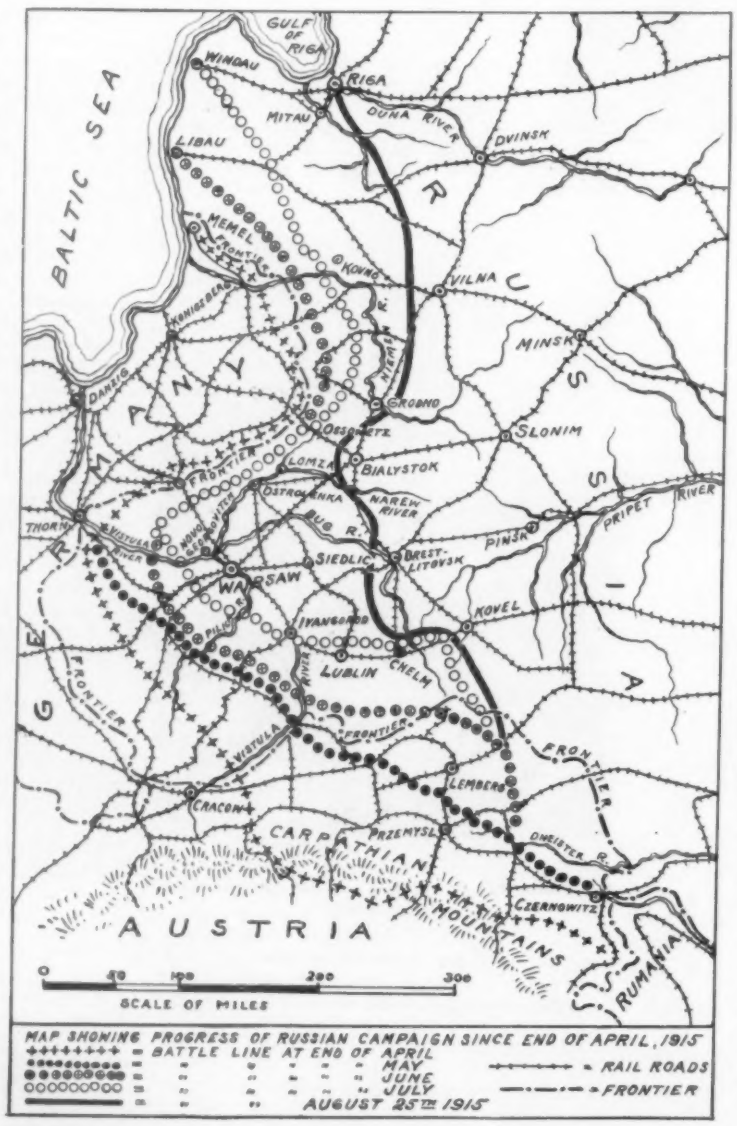
THE great campaign against Russia, which represents the supreme effort of the Teutons to eliminate the Russian army from the great war, has now been under way for nearly four months. Never was there a more eventful period in the history of warfare, or one marked by a more skillful and determined offensive on the one hand, or a more stubborn defensive in the face of tremendous odds on the other hand. Seldom in war does it happen that the commander of a defeated army is so fortunate as to share the honors of war fairly equally with the leader of the victorious host, but the unanimous verdict of the world, after watching the Grand Duke Nicholas extricate the Russian army from one desperate situation after another, is that he has won a place high among the great military leaders of history. But the question uppermost in the minds of all those who wish to see the allied cause win in this conflict is whether he can continue for another four months to escape the long and powerful arm of the Teuton and keep his army intact until winter or some fortunate diversion in other theaters of the war gives him a chance to recuperate and collect the war supplies he evidently must have before he may hope to turn the tables on the Teuton, recover the lost ground and begin his triumphant march for Berlin and Vienna.

The true purpose of these notes is to discuss what has already happened, rather than to speculate on the future, but public interest at the present time is so keenly alert to the possibilities of the next few months that there is much excuse for making a modest effort to forecast the probable happenings of the near future in the Russian campaign, so far as they can be judged by what has occurred to date.

This campaign began in the last days of April. Prior to that time, Germany had given her principal attention to the campaign in the west against France, England and Belgium, and had diverted to the east only such forces as were necessary to check and drive back the occasional incursions of the Russians into East Prussia, and to give struggling Austria the assistance necessary to save her territory south of the Carpathian Mountains from invasion. This left Russia fairly free to work her will with Austria up to a certain point, and her armies inflicted one disastrous defeat after another on the Austrian armies in Galicia and Bukowina (near the Rumanian frontier), advanced to the gates of Cracow, crossed the Carpathian Mountains in the dead of winter, and threatened Hungary with invasion.

The high tide of the Russian advance into Austria-Hungary is shown on the map. The Russian armies were in this position at the end of April, restoring their strength and supplies, depleted by the hard fighting which had brought them to this advanced position, and preparing to overrun the fertile Hungarian plains when the Teuton storm broke on them like a deluge and started the flood that has carried them farther and farther back to the line they occupy to-day. Germany had at last seen the futility of hoping to overthrow France before her armies were needed in great strength to check the Russian invasion, and with an abhorrence of half measures characteristic of all truly great leadership, she unhesitatingly abandoned her French campaign, stripped her armies in this theater to the bone, and with phenomenal speed shifted her forces to the eastern theater. We may expect this fundamental principle of sound strategy to be observed by the Teutons to the end. They are fighting on three fronts, and if the Balkan States should enter the conflict against them, the number will be increased to four. They cannot hope to win on more than one front at a time, and even to do this their forces on the other fronts must be so reduced that they may even have to make great territorial sacrifices to avoid being overwhelmed. But, so long as the Teuton can make himself superior to his enemy on one front, while holding his ground on the others, just so long will he continue to win on counts. That is what he has been doing since April.

The German leaders selected Cracow as the point from which to start the great campaign that has had but one real object—the destruction of the Russian army. The immediate purpose may have been to relieve Hungary from the danger of invasion, a later one to recapture Galicia, a still later one to conquer Poland, but always the one great mission of the Teuton host has been, and will continue to be, the complete overthrow of the Russian forces. Before Grant took command of the Armies of the North, the Army of the Potomac had ever been striving to capture Richmond, but Grant made Lee's army his objective, while seeing to it that Sherman did likewise with Johnston's army, and the ultimate destruction of these two armies ended the rebellion. The Teutons are opposed by three great armies. At the present time they are concentrating their maximum effort on the destruction of the largest



Map showing advance of Teutonic armies through Poland.

one of these. If they succeed in this effort, they may undertake the balance of their task with comparative assurance. But if they shift from one theater to the other indefinitely, whether by choice or because of necessity, without accomplishing anything decisive on any front, they will be playing into the hands of their enemies. If we interpret correctly the broad general plan of the Teutons, the Russian campaign will not end through their choice until the Russian army becomes a fairly negligible factor.

Cracow was the natural point of departure for a great drive intended to force the withdrawal of the Russians from the southern slopes of the Carpathians and to recover Galicia. Near this point the Russian line bent sharply to the east, and if the drive proved successful the portion of the line in the Carpathians would be taken in flank and rear. It was successful, and back through the mountains rushed the Russians in a desperate effort to avoid being cut off. At no time since have the Germans come so near to separating the Russian line. It actually was pierced, but in time the Russians succeeded in reforming a connected line farther to the rear, and military observers began to see the difficulty, amounting practically to an impossibility, of driving a wedge through a "thousand-mile front" and keeping it there if opposed by an able leader with plenty of reserves and good rail communications for moving them to the portion of the line in danger. This does not mean, however, that the resisting power of the Russian line may not become so reduced before this campaign ends that it will break and go to pieces before the German assaults, if they can be kept at anything near their present strength.

It would be unreasonable to suppose that the Russians were not greatly shaken by the initial success of the Germans, and events indicate that they were slow to recover their resisting power. Before this had come to pass, most of Galicia had been recovered, and the Teutons gave the world an exhibition, to be repeated often in the following months, of the ease with which their powerful artillery could reduce siege works that would have held out for months in former wars. Przemysl was the first of these fortified places to be taken in operations which lasted but a few days, and all Austria rejoiced and forgot internal dissensions in its recovery. For a month the advance of the Teutons had been practically unchecked, and at the end of May they were in the approximate position shown on the map.

The Russians were beginning to recover from the disorder and confusion of their first defeat and the genius of their great leader began to tell. A period of comparative inactivity was to be expected, to enable the Teutons to resupply and prepare for a further advance. During the first month of the campaign the northern portion of the line beyond Thorn saw but little fighting, but from this time on the Teutons pressed their campaign from the Baltic Sea to Rumania. Still, for another month the German plan was to continue to make their main effort in Galicia. The Russian line in this region was pushed back to the Bug River, Lemberg was retaken, and the advance toward Lublin and Chelm begun. Farther north, the line was advanced across the frontier from East Prussia and extended to Libau, on the Baltic. This was about the end of June, and the approximate location of the battle line at this time is shown on the map.

The future of the campaign probably was definitely shaped by the decision of the Teuton leaders at this time. It seemed impossible to pierce the Russian line, and one or the other flank must be assailed. The southern wing of the Russian army was protected by the neutral territory of Rumania and the Dniester River. The northern might be enveloped if it could be kept from securing a firm position on the Baltic, and to prevent this the landing at Windau was made and the operations against Riga begun. But the huge salient of Poland, with its vast system of fortifications for supporting a Russian counter-offensive against the portions of the Teuton line which invited a counter stroke, had to be disposed of before troops could be drawn with safety from the central and southern sections of the Teuton line and assembled on the northern wing for a drive against the Russian right.

After another period of comparative quiet, no doubt utilized by the Teutons in reforming their forces for the next great move, the concentric advance on Poland from south, west and north was begun. One after another the strong fortifications and large intrenched and fortified areas of this region fell before the German artillery and attacks of masses of men. Over Warsaw, Ivangorod, Lublin, Chelm, Lomza, Ostrolenka, Kovno, Novo-Georgievsk, and Ossowetz flowed the tide of invasion which is now beating on the defenses protecting Vilna, Bialystok, Brest-Litovsk, and Kovel. Poland has been conquered by subjecting it to irresistible pressure on three sides, and by a similar method the Teutons have captured the many strong fortifications of this area one by one. The Russian line has been bent back about each of these, beyond the range of the guns of the defenses, until the garrison had either to abandon the fortification or be shut up in it and cut off from

(Concluded on page 216.)

Correspondence

[The editors are not responsible for statements made in the correspondence column. Anonymous communications cannot be considered, but the names of correspondents will be withheld when so desired.]

A Question of Submarine Tactics

To the Editor of the SCIENTIFIC AMERICAN:

Before the leisurely reply of Germany to the President's last note, or some other incident, revives the controversy, will you explain how the submarine could have been in such deadly peril from the "Lusitania," as was emphasized so strongly in Germany's last note?

She there drops all prior claims that the liner was armed, but insists that a warning to stop would have been fatal to the submarine.

The reports of the attack all put the submarine at the time on a nearly parallel course to the steamer, about half a mile away, I think, but at any rate a considerable distance. In any attempt to ram the submarine under such a condition must not so huge a steamer have had to describe a large arc, constantly exposed to torpedoes at ever shortening range? And even if the submarine remained motionless, would it not take many minutes for the liner to reach her?

In other cases of loss from ramming the relative positions of the vessels were apparently so different from the positions in the "Lusitania" case that I have failed to see the logic of the German claim—that by no means for the first time! Can you enlighten me and many other readers? CHESTER WOOD.

Oakland, Cal.

[A merchant ship has no chance of ramming a submarine unless the latter is within close range and within a few points of the ship's course, and the ship is traveling at good speed.—EDITOR.]

Locomotive Valve Gear

To the Editor of the SCIENTIFIC AMERICAN:

In your July 24th, 1915, issue I read a write-up on the Stephenson and Walschaerts valve gear. I got very much interested in it, being, as I am, an old railroad engineer from the New Jersey Central Railroad.

I became so much interested that I would like to say something along that line.

Now, gentlemen, please pardon me if I make the bold assertion that there is no such thing as constant lead, because the lead is decreasing all the time on account of constant wear. For example, we will give the Walschaerts gear one eighth inch lead, say to-day, and one year from to-day it will have lap. So there is no economy nor durability about this kind of gear. About all that can be said about the Walschaerts gear is that it is the nearest to a direct motion.

We have the Walschaerts gear on engines in this country and you can hear them pound a mile away.

Now, gentlemen, the Stephenson valve gear is economical and durable and applicable to fast and slow trains; but if you want to give it a constant lead, make the link straight instead of curved.

Now, the master mechanics talk about tinkering with the valve motion. There can be no tinkering with it if the eccentrics are keyed onto the shaft.

I think the master mechanics should be thinking of something that is of some benefit to the company which they represent than trying to invent something to stop men from tinkering with valve motion. They could better employ their minds to something along the line of piston clearance. This is a great, big question. If I were going to build a hundred engines, I would give them not less than one inch clearance in each end of the cylinder. I know this is right, for I have had the experience.

Would like to say more, but this is probably enough for this time. H. E. CHURCH.

Alexandria, Neb.

A Plea for National Defense

To the Editor of the SCIENTIFIC AMERICAN:

I have followed your articles dealing with our lack of preparation in case of war. It seems that the press and public is generally agreed that we are in a woeful condition in this respect, and that the Americas will be tempting ground after the world war.

It has seemed to me that the thing to do is to start something that will remedy this defect. Action, and vigorous scientific action, is what is needed now.

Of course, we all realize that this responsibility rests upon Congress, but if they refuse to act, and act now, let the American people take it into their own hands. I can think of nothing more patriotic or exemplary than for the leading periodicals of this nation to put their words into action. Let them get together and outline some definite policy, and then set about to accomplish it. I have reference to their forming private military organizations and drilling, or unite with the National Guard, if necessary. We poor mortals look to the higher-ups to set the example, and then we can follow.

Then let a nation-wide campaign be started to elect statesmen and patriots to our Congress instead of politicians and demagogues. Another thing that strikes me as queer is the feeling against each man being required to have military training, and be united with some definite organization in case of need. They forget that every male in this country, who is of military age, is liable for duty in case of war, as evidenced in the civil war. Then surely it is far better to be trained and equipped that you may meet the foe on an equal basis. Property owners raise the greatest cry against military training, and yet they are the first to suffer, in a financial way, in case of an invasion. Then their outcries against the dilatory Government would be the greatest.

In other words, let us start something—action, get action, form an alliance with all South America to unite against any foreign invasion, and influence them to build up their navies and armies, and then see to it that we do not get the detestable chip on our shoulders. That will prolong our peace. In case of war, if come it will at the instigation of a foreign foe, then we will be prepared to deal quickly with this aggressor, and save hundreds of thousands of lives and millions of dollars by being fully and amply prepared and all citizens trained, as it is their patriotic and sacred duty to be in defense of their homes, their nations, and the loved ones around them. C. G. MINER.

Oregon City, Ore.

Compulsory Working of Patents

To the Editor of the SCIENTIFIC AMERICAN:

In your issue of June 12th a correspondent who hides behind the initials "J. N. V.," and who, nevertheless, complains that my letter did not state my relation to the textile industry, makes the following statement in reply to my letter on the compulsory working of patents:

> "There is always a sure, quick and infallible test to apply to enthusiasts with legislative proposals; and that is, to compel them to phrase in specific language just the law they want."

The almost invariable course adopted by those who would maintain a legislative abuse is to call on the reformers to frame an amendment to the law showing just what they want. The obvious object of such tactics is to enable the defenders of the *status quo* to divert attention from the abuses in existing law by directing an attack on the specific terms of the reformer's proposal. The device is particularly valuable when the abuse itself, as in the case of our patent law, is beyond question. The abuse is the main point at issue, and the particular phraseology to be employed in applying the remedy is of secondary importance at the present time. Surely the men representing the people in Congress, aided by the wisdom of the American bar and the accumulated experience of other countries, should be able to frame an effective working clause for the United States.

As a suggestion, however, I would call attention to the German statutes. Previous to 1877, Germany had no patent law, it having been the policy of Bismarck to develop German resources by enabling German manufacturers to appropriate without restriction all the inventions of other countries. When, at last, a German patent law was enacted in 1877, it contained a working clause which was re-enacted in the law of 1891 in the following form:

> 11. Das Patent kann nach Ablauf von drei Jahren, von dem Tage der ueber die Erteilung des Patents erfolgten Bekanntmachung (27 Absatz 1) gerechnet, zurueckgenommen werden:
>
> 1. wenn der Patentinhaber es unterlaesst, im Inlande die Erfindung in angemessenem Umfange zur Ausfuehrung zu bringen, oder doch alles zu tun, was erforderlich ist, um diese Ausfuehrung zu sichern;
>
> 2. wen im oeffentlichen Interesse die Erteilung der Erlaubnis zur Benutzung der Erfindung an Andere geboten erscheint, der Patentinhaber aber gleichwohl sich weigert, diese Erlaubnis gegen angemessene Verguetung und genuegende Sicherstellung zu erteilen."

Translation of above:

Article 11 of the Bill of 1891 as Passed into Law.

> Article 11. A patent may be revoked after the first three years of its existence, reckoned from the day of the definitive allowance of the same:
>
> 1. If the patentee shall not exploit the invention in the country to an adequate extent, or shall not do all that is necessary to insure such exploitation;
>
> 2. If, in the public interest, the grant of a permission to others to use the invention appears desirable, the patentee shall decline to grant such permission against adequate compensation and sufficient guarantee.

The efficiency of a working clause is to be judged not by the number of patents revoked, but by the industries which it builds up. That the German working clause was actively enforced is, however, attested by the fifteen cases of revocation under it from 1881 to 1892.

Under this policy of no patents at all or patents that can be revoked if not worked in Germany, the industries of that empire have been developed for forty-four years, and that development has been promoted by the fact that the United States and Great Britain gave to owners of German patents a complete monopoly or control of their inventions in those countries.

When, in 1908, it was proposed to remedy this humiliating situation by the enactment of a compulsory working clause in the United States, the German government persuaded the Government at Washington to accept the Bacon-Bernstorff treaty, which provides that working a patent in either country, say Germany, is equivalent to working it in the other country, the United States. At that time Germany had succeeded in gaining control of the dyestuff industry, so that the treaty served to strengthen her position. During the forty-four years since the German empire was founded, German policy in respect to patents has been directed unceasingly with the object of protecting and developing German industry and power. During the same period American policy has been marked by a neglect of American interests and a stupid standpat adherence to a United States law that was actually strengthening German monopoly. It is a striking contrast between German preparedness and American neglect.

An illustration of the situation to which this one-sided arrangement has powerfully contributed is found in the textile industry, which is now seriously crippled by the loss of German dyestuffs. As a result Americans will, if the war lasts, be compelled to wear clothing, a large part of which will be dyed a limited number of fugitive shades. In the face of this humiliating situation it seems needless to give serious consideration to "J. N. V.'s" sophistries, but to remove any possible misunderstanding, I will refer briefly to the points he raises.

(*a*) The British working clause of 1907 was nullified by a court decision placing the burden of proof on the petition for revocation. The necessities of the war has forced the British government to remedy that defect by providing for the licensing of German inventions patented in Britain. The German patents have not been revoked nor confiscated, but licenses are issued for a fair compensation which is to be held in trust by the British government. This is the result which the working clause of 1907 was intended to effect, namely, to put an end to the suppression of inventions by means of British patents for the benefit of foreign nations. That is the example which the United States should follow, even if "J. N. V." looks upon the idea as "dementia."

(*b*) The tariff on dyestuffs was omitted from my letter in order to avoid diverting attention from the patent question, and not because its importance was ignored. I have found no reason to modify my views on this point as stated in September, 1914:

> "In addition to a working clause, a tariff should be imposed on artificial dyestuffs to protect the new industry against both legitimate and unfair foreign competition. To effect this object, the rates to start with should be specific. A tariff without a working clause would serve only to increase the price of dyestuff to the American consumer. A working clause without a tariff would mean but partial relief. The working clause combined with the tariff would enable the United States to liberate itself from its present dependence on foreign countries and provide a domestic supply at a fair cost."

(*c*) As for the literature on the subject, "J. N. V." is mistaken in assuming that I am wholly unacquainted with it. The hearings before the House Committee on Patents have received special attention, and nowhere have I found any statement of fact or argument to justify an arrangement by which the United States law operates to suppress industries in the United States and develop them in Germany and other foreign countries. While I have found in the literature on the subject no valid argument against a compulsory working clause, I have found reasons for the fierce opposition to such a clause.

The foreign interests are in opposition because it would put an end to their special privileges under United States law. And there are powerful domestic interests that are in opposition because they fear a working clause would not be confined to foreign patents, but would, sooner or later, be extended to domestic patents. Like the defenders of Schedule K in 1909, they do not want the legislative box opened for fear they will never get their special privileges back into it again. And the fate of Schedule K carries the lesson to the patent standpatters of 1915, that it is always dangerous and frequently fatal to resist a demand for justice.

Boston, Mass. SAMUEL S. DALE.

A Small Aero-Electric Plant

Making the Wind Generate Electric Current

By E. H. Williamson, Jr.

THERE are many articles dealing with the construction of small dynamo-electric machines, but few mention any method of supplying the machines with continuous power after completion.

They can, of course, be run for a few minutes at a time by foot power, but for practical service it is necessary to utilize some form of power, such as steam, gasoline, water or wind. The last will be considered in this article.

If the reader is a dweller in a city, and is fortunate enough to possess a roof unobstructed by other buildings, he can, with the apparatus to be described, develop from 40 to 60 watts of electric power with a wind velocity of from 12 to 18 miles per hour, the fluctuating nature of the power being compensated for by the use of a small storage battery, fitted with a suitable cut-out.

To construct the wind-wheel saw out two circular pieces of ⅞ inch straight grain yellow pine, 12 inches diameter, also 20 strips of the same 2 feet long and 1 inch square. The circles are to be screwed together with the grains crossed, and form the hub of the wheel as shown at *A* in the detail drawing of the wheel. The strips are sawed down diagonally to a depth of 10 inches from one end, and one portion is cut away, leaving a triangular section. The other ends are beveled for 2 inches to a width of ½ inch, the whole appearing as in *B* in the drawing.

From a dealer in sheet iron, obtain 20 triangular pieces of No. 28 galvanized iron, 12 inches wide by 15 inches deep. Cut the corners round, clamp them together and drill two ¼-inch holes, 4 inches apart, as shown in *C*. A sheet, or fan, is now screwed to the triangular portion of each strip, using 1-inch No. 8 screws, and the strips are screwed to the face of the hub *A* like the spokes of a wheel, the whole appearing as in the drawing. Holes should be drilled for all the screws to avoid splitting the wood. Limits of space prevent us from describing the particular dynamo shown in the accompanying photograph, but the reader, no doubt, has access to directions for constructing small dynamos, or he may prefer to purchase one ready made. He should buy one developing from ten to twenty-five volts at 2,500 revolutions per minute and standing not more than six inches high.

The writer tried out several methods of transmitting power from the mill shaft to the dynamo, including bevel gears, belting, etc., and finally found that mounting the generator on top of the tower, and gearing it directly to the wind-wheel shaft, gave the greatest efficiency. The photos show the actual appearance of the parts as constructed, and details are shown in one of the drawings.

The box is made from ⅞-inch yellow pine; the end walls *E* in the drawing are 16 inches high by 8 inches wide. They are secured to the bottom board *F*, which is 8 inches wide by 12 feet long, with four small iron rectangles, not shown. The board *S'*, which holds the dynamo, measures 8 by 12 inches, and is 4 inches above the bottom board, but this dimension would vary with the size of the dynamo. The dynamo should be set on the shelf *S'* and screwed firmly in such a position that the rear end of the shaft will protrude half an inch through a 1-inch hole bored in the left-hand wall *E*. We next require four gear wheels, one 8 inches in diameter, ¾-inch hole; one 3½ inches in diameter, ½-inch hole; one, 1 inch in diameter, ½-inch hole, and one 7/8 inch in diameter, 5/16-inch hole. All are of ⅝-inch face, pitch No. 20.

We next require 2 feet of ¾-inch shafting, 4 inches of ½-inch shaft and 6 inches of heavy brass tube of a size to slip easily on the ¾-inch shaft, also 14 inches of ¾-inch galvanized iron pipe threaded at both ends and provided with two round screw flanges. The ⅞-inch gear is now carefully reamed out to a driving fit on the dynamo shaft and is forced thereon as shown at *G*. The 1-inch and the 3½-inch gears are mounted on the ½-inch shaft as shown at *H* and *I*, the former being held with a set-screw, and the latter screwed to the hub of *H*. These gears are supported by bearings *J K*, the inner one being screwed to the wall, and the outer being supported on two ⅝-inch bolts 4 inches long, clamped on brass tube sleeves, similar to the dynamo bearings.

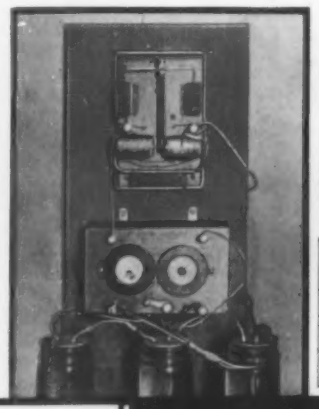
The bearings are of 1 by ¼-inch brass bar, and must be adjusted so that the gears *G* and *H* mesh freely. The large gear *L* is driven upon the ¾-inch shaft to a distance of 7 inches, and the latter is mounted in 3-inch lengths of the large brass tube mentioned, which has been driven through holes in the walls *E* of the box. The position of the bearings must be carefully adjusted at such a height that the teeth of the gear *L* mesh freely with those of the 1-inch gear *I*. Notches are filed in the tubes as shown at *G*, exposing the shaft, and in these are set iron washers *M*, which dip into pans of oil below and keep the shaft lubricated. Grease pockets are provided for lubricating the bearings of the dynamo shaft. The grease box, shown in section, also lubricates the inner end of the ½-inch shaft. The outer end is provided with a block of wood bolted to the bearing, in which a pocket has been cut and filled with grease.

The gears must, of course, be completely protected from the weather by a cover which may be of wood or tin.

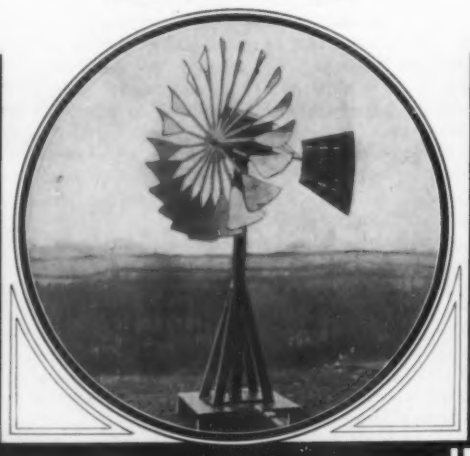
The wind-wheel is mounted on the shaft by means of the ¾-inch iron pipe *N*, a 6-inch length of which is cut off with the flange attached, the latter being bolted to the wooden hub of the fan. The pipe should be reamed out to slide easily on the ¾-inch shaft and a ¼-inch hole drilled through both pipe and shaft for a set-screw. The other section of iron pipe and its flange is bolted to the bottom of the box under the dynamo, the pipe resting in a 1-inch hole bored vertically in a block of 3- by 4-inch yellow pine, which is bolted to the upright supporting the mill. In order that the mill may face any wind, it is necessary to have a brush contact such as shown in the photograph under the mill. A plug of hardwood drilled through the center is driven into the end of the iron pipe. It is provided with two rings cut from brass tube and screwed to the wood, a wire running from each ring up through the pipe to the dynamo. The brushes are brass springs which bear on the rings and carry off the current.

The sides of the house are of ⅞-inch pine, one side being hinged to allow of access to the interior.

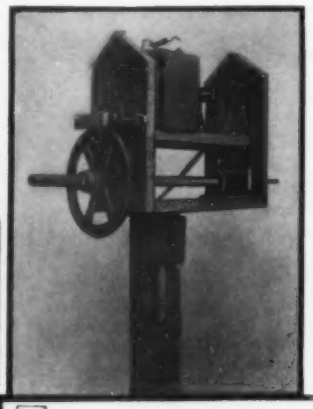
The automatic cut-out.



The wind-wheel power-plant.



Dynamo box and gearing.



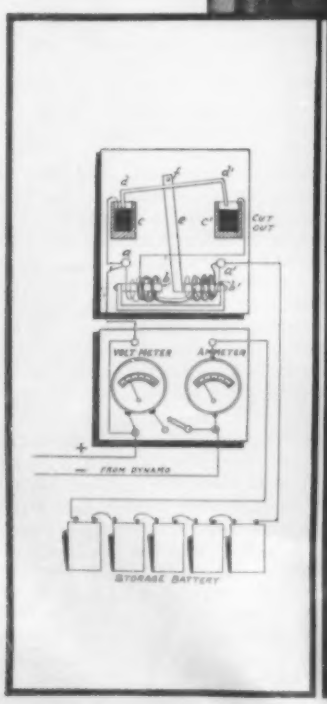
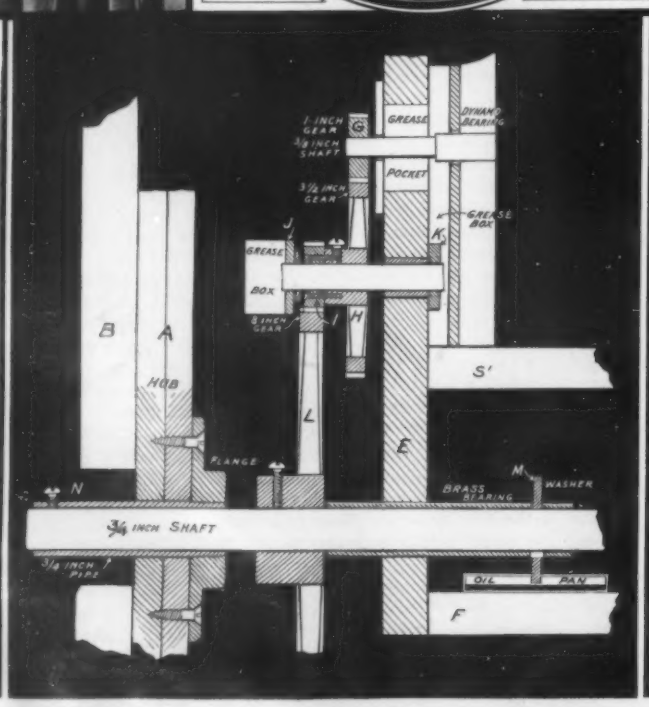
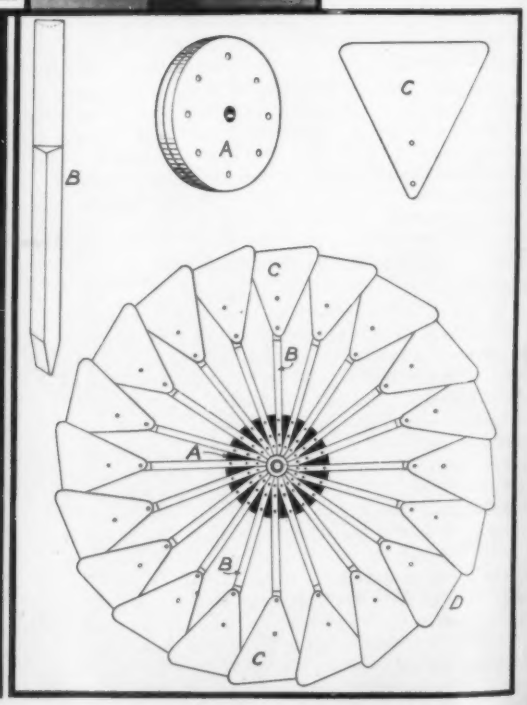


Diagram of the cut-out.



Gear train connecting the wind-wheel with the generator.



Constructional details of the wind-wheel.

and the roof boards may be of ½-inch stuff covered with a sheet of tin. The brush contact should also be protected with a piece of tin nailed over it. The whole house, and the wheel, with the exception of the fans, should be painted with at least two coats of good quality oil paint. The tail, which is shown in the photograph of the completed mill, may be made of either tin or thin wood, but should extend 4 feet back of the box with a wind surface of at least 4 square feet. It should be bolted to a large angle iron screwed to the rear of the box with additional supports of iron wire, attached to screw hooks in the upper part of the wall. The support of the mill will vary with the location in which it is to be used, the arrangement shown in the photo being handy for use on a roof. In any case the support must be securely guyed to avoid danger of the apparatus being blown over in a high wind.

With a wind velocity of from 12 to 20 miles per hour this wind-wheel will give from 70 to 100 revolutions per minute. As the dynamo is geared at a ratio of about 30 to 1 to the main shaft this will give armature speeds from about 2,300 to 3,200, and a 15-mile wind will average 25 volts. The mill speed does not increase directly with the wind velocity, as the magnetic drag on the armature becomes greater in proportion as the generator speeds up, and acts as a brake on the whole machine. Should it be known that a great wind storm was approaching it would be better to free the wheel on the shaft by removing the set-screw and letting it run clear.

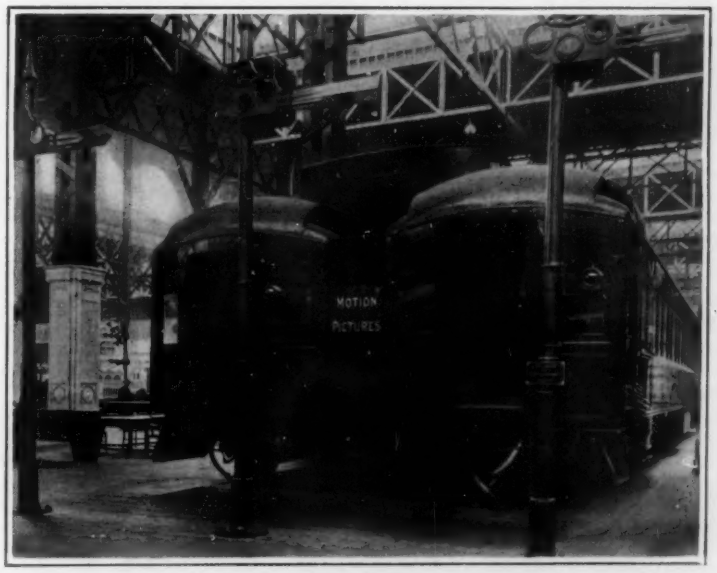
As mentioned at the beginning of this article, it is necessary to employ a storage battery and automatic cut-out in order to enjoy any benefit from a fluctuating source of power like the wind. Any small storage may be employed if the number of cells is limited to eight, as this is all that the average output of the generator can take care of.

The cut-out is an adaptation of the one described in Mr. F. E. Powell's book on "Wind Motors." The dynamo current traverses the circuit to the lower binding posts of the meter board where it passes through both volt and ammeters to the upper posts. Thence it passes to post *a* on the cut-out board, then through the fine wire coils on the magnets *b* and *b'*, post *a'* to the storage battery, to upper post on meter board, and so back to the dynamo. A wire runs from the post *a* to the mercury cup *c*, which is made of hardwood. The rod *d d'* is of No. 12 bare copper wire and the end *d* always dips in the mercury in *c*. The wire is attached at the center to a pivoted support *e* to which is fastened a bar magnet *b* from an old telephone receiver. When the lower end of this magnet rests against the pole of the right-hand magnet *b'* the end of the No. 12 wire is out of the mercury in the cup *d'*. In the other position, the wire dips in the mercury in *d'*, shunting the fine wire coil and connecting the battery direct to the dynamo through the heavy wire coils *f*. The magnet *b b'* may be made of an old bell magnet wound with No. 36 copper wire, enough to make a resistance of at least 300 ohms. The heavy wire should be six layers of No. 18 on each magnet, wound in the same direction as the fine wire. The action is as follows:

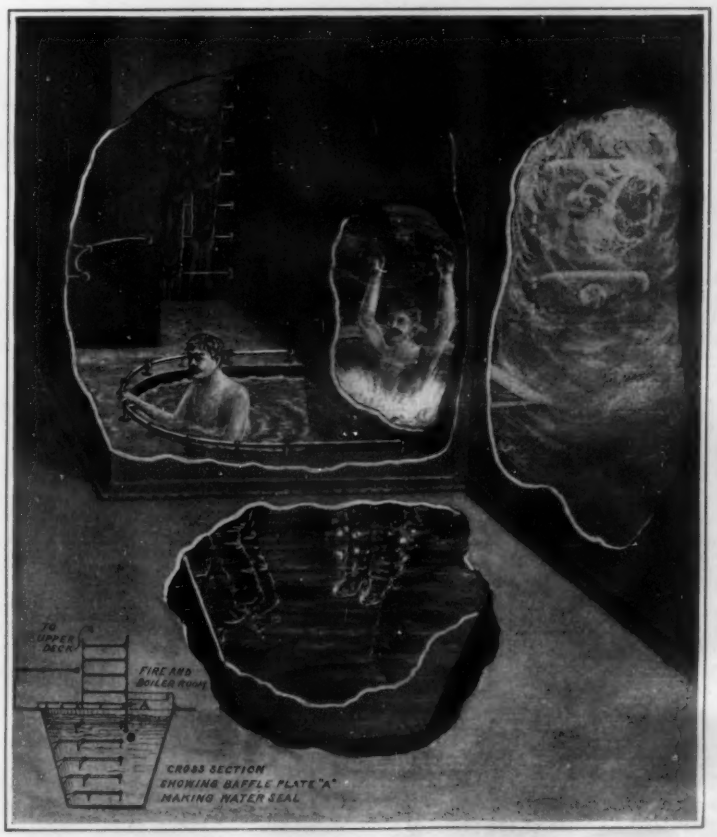
We will suppose the magnet to be at the right-hand side of the space between the poles of the electro-magnet, and the battery to be in series on the fine wire coils.

The wind-mill now attains speed, raising the voltage of the dynamo circuit until the pressure is great enough to reverse the direction of the current in the fine wire, thereby reversing the poles of the electro-magnet and attracting the permanent magnet to the left, bridging the fine wire with the No. 12 and cutting out all resistance. The wind now drops and the battery current pulls the magnet to the right again, breaking the circuit at *d' c'*. If the wind is very uneven it is better not to try to charge the batteries, as the cut-out will not work unless the batteries have some initial charge.

The comfortable interior of the railway theater.



Motion picture theater made of two railway cars.



A new emergency exit to prevent steam passing into the escape trunk and asphyxiating the men.

If the reader desires a plant of greater power, the size of the wheel may be increased, with, of course, a similar increase in the size and strength of the materials used. For a 10-foot wheel the hub should be of treble thickness, and at least 30 inches in diameter, and the fan blades about 24 inches by 20 inches. The shafts and the size of the gears would also be increased proportionately. Such a wheel is said to give from ¼ to ½ horsepower in a wind of from 15 to 30 miles per hour.

Railway Motion-picture Theater

ONE of the novel features of the railway exhibits at the Panama-Pacific International Exposition is a motion-picture theater made of two standard steel passenger cars, as shown in the accompanying photographs. The cars have been placed on parallel tracks about twelve and a half feet apart from center to center, and the adjacent sides of the cars have been removed. The space between them has been bridged over with temporary side sills, laid with standard car flooring, the side sills being tied together with a few temporary steel braces and tie rods. The roof has been filled out to cover the gap between the cars, and the final result is an excellent moving-picture theater with four rows of comfortable, upholstered seats, and window panes ornamented with various designs symbolic of the country through which the railroad runs. The total inside width of the theater is twenty-one feet. Here illustrated lectures are given on the cities and countries traversed by this railroad. The effect is almost that of actually taking a trip, particularly as the uniforms of the attendants give a touch of realism to the lecture. The lectures are given at stated hours, admission being by free souvenir ticket.

Emergency Exit from Boiler Rooms

AS matters now stand there is no part of a ship's complement, whether in the merchant marine or the navy, that is exposed to such imminent danger in case of disaster as the engine and boiler room forces, and particularly the latter. The use of forced draft, which places the whole interior of a boiler room under pressure, makes it necessary that all means of access to and exit from the boiler room compartments shall be closed while forced draft is in use. In the majority of cases the means of exit from a boiler room consist of openings in the roof, reached by vertical ladders which are normally closed by steel covers. In other cases means of escape consist of watertight doors leading to adjoining compartments. In the event of the boiler room becoming filled with steam, as the result of the bursting of a steam pipe or the drawing out of tubes resulting in a rush of steam through the fire doors, the crew are in danger of being suffocated and scalded to death before they can make their escape.

Recently on two of our warships, the "New York" and "Texas," inclined steel trunks have been built outside of the fire-rooms, which lead from escape doors on the fireroom floor up to the gun deck. These are good as far as they go; but there is always the danger that the hot steam rushing up the inclined stairway through the open door will asphyxiate the men on the ladders, causing them to fall upon their companions below and resulting in the asphyxiation of the crew as they lie jammed at the bottom of the escape.

To overcome this defect and render these emergency escapes safe against the passage of steam and gases, Mr. Ernest H. Peabody of the Babcock & Wilcox boiler company, has designed the ingenious and very effective water-seal arrangement, which is shown in the accompanying engraving. At the right of the picture is seen the side wall of a boiler compartment,

(*Concluded on page 214.*)

The Heavens in September

New Light on Variable Stars; Positions of the Planets

By Prof. Henry Norris Russell, Ph.D.

IN last month's article attention was called to a number of variable stars of short period which were conveniently observable. Few celestial objects have been subjected to more thorough study in recent years than the stars of this type, and the quantity of information concerning them which we now have at our disposal is very considerable. Yet they still present to the astrophysicist one of the most perplexing problems in his whole field, and the contrast between the extensive knowledge which we possess about their behavior and our very scanty understanding of their true nature is at once stimulating and tantalizing.

There can be no doubt that these variable stars constitute a "natural class" and not one created artificially by our methods of classification.

If we take all those variable stars whose changes are periodic in character, arrange them according to the length of their periods, and set aside the easily recognizable eclipsing variables (which would not change in brightness at all if we did not happen to be so situated in space that their attendant companions passed nearly in line between us and them) we will find that the remaining stars fall quite definitely into two groups. There are more than twenty stars with periods less than a day, and three or four times as many with periods of from two or three days to as many weeks. Then comes a conspicuous gap—periods of two or three months being very rare—after which we come upon hundreds of stars whose periods range from six to eighteen months.

These variables of long period are for the most part of large range of brightness, being often a hundred or more times as bright at maximum as at minimum, and are not accurate time-keepers, being sometimes a month or so early or late. The short-period variables, on the other hand, come very nearly, if not exactly, to time at each maximum, and their changes are of comparatively small range, very few being as much as four times brighter at maximum than at minimum, and the average ratio of change being between two and three fold.

In addition to these points of similarity it is found that among these stars the increase in brightness is more rapid than the following decline, occupying usually from one half to one third as long and sometimes less. In a few instances the rise and fall take about the same length of time, but a slow rise and rapid fall have never been observed. The relative duration of the increase and decrease, as well as the range and other characteristics of the variation, appear to be quite definitely fixed for each particular star, and the "light-curves" which illustrate them, though differing from star to star, show a very strong family likeness. Moreover, along with their changes in brightness go changes in color, not great enough to be detected directly by the eye, but easily distinguishable by comparing visual and photographic observations; and in every case the star grows redder as it becomes fainter, and whiter again as it brightens.

In actual color and in the character of their specter, the majority of the variables with periods of a week or two resemble the sun pretty closely, though some are whiter, and presumably hotter, resembling Procyon rather than the sun in spectrum, and others are redder, like Arcturus, and are probably cooler. The stars with periods shorter than a day, however, are much whiter and presumably hotter, resembling Sirius in spectrum. It seems, therefore, to be true that the shorter the period the whiter is the star, but there are some exceptions to this rule.

There is evidence in a few cases that as a star changes in brightness and color its spectrum also varies in the direction and to about the same extent that we would find in passing from one ordinary star of the same color as the variable at maximum to another of the color which it shows at minimum.

As regards their positions in the heavens, the stars with periods less than a day are scattered apparently at random, but those of longer period are practically confined to the Milky Way and its immediate neighborhood. This marked contrast indicates that there is some real difference between the two groups. Confirmation of this is found in the fact that the stars of period of a week or so (which form the largest and more important group) have invariably small proper motions, and are very remote from us, while those of shorter period, though fainter to the eye, show in at least one case a much larger apparent motion. From these proper motions it is possible to find the average distance of about a dozen of the brightest of these stars, and it comes out surprisingly great—about 500 light-years. It follows that these stars are really of enormous brightness—a typical one ranging from about 500 times the Sun's light at minimum to 1,000 at maximum.

Since these stars are similar (in a general way) to the Sun in spectrum and, therefore, in all probability also in brightness of surface, it is reasonable to suppose that, to shine so brightly they must be much larger than the Sun, probably ten million miles or more in diameter, according to the best estimates we can make. The whiter stars of period less than a day are probably much smaller.

Finally, it must be recorded that every one of these variables which has been investigated appears to be a spectroscopic binary—the lines in the spectrum shifting their positions regularly, with the same period as the changes in light. In every case, the time when the star is approaching us most rapidly, according to the spectroscopic data, falls very close to the moment of maximum brightness, and the time of most rapid recession is close to that of minimum light. Moreover, the range of variation in spectroscopic velocity is proportioned to that of the light variation—the two rising or falling together as we pass from one star to another.

The size of the orbits computed from the spectroscopic observations is, however, smaller in the case of these stars than for most others. The average distance of the center of such a star from the point about which it revolves in its orbit is less than a million miles, so that the stars themselves are probably much larger than their orbits. At first sight this may seem absurd; but we must remember that the center of the orbit of any astronomical body is the center of gravity of itself and its companion in the orbital motion, and that this center of gravity is an imaginary point, on the line joining the centers of the two bodies, and nearer the more massive one. If the companion body is relatively small, the center of gravity will be very near the center of the larger body and may be inside its surface, as happens in the case of the Earth and Moon, and apparently in that of these stars as well.

After stating at this considerable length a mere outline of the principal facts which are now known to be true for the stars of this class, we can spare but a moment's glance for the theories, so far unsuccessful, which attempt to explain the facts.

The changes in light, color and spectrum, by themselves, seem to point strongly to a change in the temperature of the star's visible surface as their origin; but how such a change may be brought about, in some cases in an hour or two, over the whole surface of a body bigger than the Sun is very hard to see.

The most obvious idea is that we have to do with stars which are hotter, and hence brighter and whiter, on one side than on the other, and which present first one side and then the other to us as they rotate. But this will not explain why the stars are approaching us fastest when they are brightest, nor, as mathematical analysis shows, could the rapid rise and slow diminution in brightness which occurs in many of these stars be accounted for by the mere rotation of a spotted body however the spots were arranged upon its surface.

Another apparently promising theory assumes that for one reason or another the star is brighter and hotter on the side which faces forward in its orbit than on the opposite face. This explains the singular relation between the times of greatest brightness and most rapid approach; but it breaks down if, as appears very probable, the stars themselves are larger than their orbits, and, moreover, it gives no reason why the rise of brightness should always be quicker than the fall.

It is possible that the origin of the changes may lie in an alternate expansion and contraction of the star itself—some pulsation on a gigantic scale, in the course of which the star's temperature rises and falls; but this theory, too, has difficulties of its own.

While phenomena like this, evidently representing a standard process of stellar behavior—perhaps of stellar evolution—remain unexplained, it is clear that the astronomer, at least, need not weep because there are no worlds left to conquer.

At 11 o'clock : Oct. 7.
At 10½ o'clock : Oct. 14.
At 10 o'clock : Oct. 22.
At 9 o'clock : Nov. 7.
At 8¼ o'clock : Nov. 16.
At 8 o'clock : Nov. 23.
At 9½ o'clock : October 30.

NIGHT SKY: OCTOBER AND NOVEMBER

The Heavens.

The principal constellations are shown so clearly on our map that they require but little description. The great square of Pegasus, high in the southeast; the cross of Cygnus, just west of the zenith; the Great Dipper, low on the northern horizon, and the zig-zag line of Cassiopeia, high in the northeast, may serve as skymarks from which to proceed. Below Cassiopeia we find Perseus and Auriga, with Taurus rising on the right. Below Pegasus in the southeast are Pisces and Cetus, dull constellations, in a region now enlivened by the brilliant planet Jupiter. In the south are Aquarius and Capricornus, and below these the bright star Fomalhaut. Aquila is conspicuous at the top of the brilliant region of the Milky Way in the southwest, while Lyra, Hercules and Corona are north of west, below Cygnus, and Draco and Ursa Minor are above the Dipper in the north.

The Planets.

Mercury is an evening star throughout September, and is best seen in the latter part of the month, about the time of his elongation on the 26th; but as he is very far south, he is ill-placed for observation in our latitude, and at best sets only a little over fifty minutes later than the Sun.

Venus is in conjunction with the Sun on the farther side on the 12th and is invisible while passing from the morning to the evening skies.

Mars is a morning star in Gemini, rising just after midnight in the middle of the month.

Jupiter comes to opposition on the 17th and is the chief glory of the midnight sky, appearing more than twice as bright as Sirius and ten times brighter than any other star now in sight. His satellites afford a beautiful spectacle with a small telescope, or even in a field-glass. With a larger instrument it is of great interest to watch the satellites and their shadows crossing the planet's disk. The third satellite may be thus seen on the evening of the 2nd, the first and afterward the second on September 7th, the first on the 23rd, the second on the 25th (at which time also the fourth is behind the planet), and the first on the 30th.

Saturn is a morning star in Gemini and is in conjunction with Mars on the 10th, the two planets being little more than a degree apart.

Uranus is in Capricornus, well past opposition, but

(Concluded on page 214.)

Effect of the War on American Industries—I

Permanent Value to Manufacture on Our Soil with Our Native Raw Materials

By Edward Ewing Pratt, Chief, Bureau of Foreign and Domestic Commerce

A PSYCHOLOGICAL study of the average American citizen, during these past months of intense absorption in the world conflict across the waters, would reveal a marvelous composite of mental moods—wholehearted sympathy with the millions of sufferers, fears for the test to which democratic ideals are being subjected, longing for permanent relief from the possibility of war in the future, and the heavy burden of military preparation, anxiety for the maintenance of our own position, as the one powerful nation not involved in the terrific clash of arms, and a score of other feelings connected with sentiment, duty or interest.

Prominent among these are the instinctive questions arising as to the effect of the world's turmoil on our own people. What will be the outcome in regard to our political institutions, our standards of international morality, our future relations to the different contestants in the bitter struggle, our whole fabric of American life, social, intellectual, spiritual, and material? A small army of experts in all the fields of human activity are tasked to consider all of the queries in this connection. My own daily duties require me to study closely one of the many fields involved, that of the nation's industries, as affected by the Great War, and as a close corollary, the effect upon the exchange of the products of these industries, i. e., our own national commerce, domestic and foreign.

The influence of the war upon our American industrial life is of a two-fold nature. There are direct, visible results, essentially of a transitory nature, and destined to terminate with the approach of peace. There are other results, less evident to the eye, but increasing with each added day of the conflict, and bound to be of far-reaching import in the evolution of our industries.

In the first category falls the feverish activity developed in connection with the effort to swiftly supply the enormous needs of four nations in arms. We are furnishing not simply vast quantities of livestock and foodstuffs, but almost as great amounts of everything needed to equip armies, and repair the heavy wastage of war—shoes, wearing apparel, saddlery, motor trucks, all possible forms of railway material, iron and steel in multitudinous shapes, such as barbed wire, bridge material, etc., lead, zinc and copper, especially the last two, fire-arms of every description, from revolvers to siege guns, cartridges and particularly shells. These are leading items. A detailed list would resemble the inventory of a country store.

All of this commercial movement will cease with the order to "break ranks" in Eastern and Western Europe. It will exert no enduring influence on the development of our industrial life, as far as new markets for its products come into consideration. The only after effects demanding attention are those connected with our domestic economic condition when these vast war contracts expire.

For the time being, the exceptional activity of the branches enumerated has been of material aid in the general recovery throughout our land from an industrial depression, shared in common with the rest of the world, and due to the economic reaction following the recent Balkan wars. In each of the branches in question, every workman already skilled in any one of the varied processes is steadily occupied, and thousands of men and women, unemployed for months before, have been swiftly trained to novel manipulations. The result has been a most welcome solution of the problem of unemployment in scores of manufacturing centers. An equally unwelcome experience will probably follow any sudden cessation in the call for supplies and munitions, when the warring millions of Europe return to their deserted work-benches, looms and furnaces, and the abnormal activity of American mills and factories comes to an abrupt close.

In what condition will these varied plants be left, at the approach of peace? In some categories there have been no material addition to buildings and equipment. This is essentially the case with our flouring mills, tanneries, harness shops, shoe factories, and clothing factories. Their capacity has been taxed to the utmost, but no notable additions to plants are recorded. Some enlargement in the case of shoe machinery anticipates slightly the normal necessities of replacement.

In the case of machine tools, there has been great difficulty in meeting the urgent demands for lathes to turn the millions of steel shells for which contracts have been taken in this country. The rigid requirements in regard to the diameter of shells, involve the use of lathes of the highest precision and accuracy. The advent of peace will find thousands of lathes doomed to idleness throughout the eastern tier of Northern States. This excess will possibly be gradually worked off in supplying foreign markets at reduced rates. In practically all cases, the cost of this extra mechanical equipment has been written off in the high prices charged for munitions. It is to be noted, however, in this connection, that the foreign demand for metal-working machinery, especially lathes, has augmented in unprecedented proportions. Thus, in the month of May, 1915, the values of our exports under this category, as compared with those of May, 1914, were as follows:

	May	
To—	1914	1915
Canada	$69,000	$292,000
France	159,000	1,229,000
United Kingdom....	281,000	1,737,000
Australia	.....	22,000

It is evident that we are not only meeting an urgent present need in the above countries, but that we are shipping such a stock that the normal needs of the lands in question will be covered for years to come. In addition, the high qualities of American machine tools have received a magnificent advertisement, and business relations have been established, which may be ultimately of inestimable value in all lines of industry.

The manufacture of rifles, cartridges, fuses for shells, etc., has called for a great multiplication of specialized mechanical equipment, much of which cannot be very advantageously utilized in times of peace. Some may be sold to foreign arsenals. The rest forms an important asset in the nation's material resources for defense against invasion.

The normal equipment of our steel works has thus far been adequate to furnish the necessary supplies required in the manufacture of shells. Far otherwise is the case with regard to the contents of these shells. Our factories for the production of high explosives were totally unprepared to furnish more than a fraction of the tons and tons of picric acid and trinitro-toluol needed on the firing lines in Europe. It meant the construction of extensive new plants for the manufacture of the deadly compounds. It meant further an enormous expansion in the output of nitric acid and sulphuric acid, required to change phenol and toluol into explosive forms. The tar works of the country could supply but a very limited amount of phenol or carbolic acid. It was necessary to manufacture it on a large scale, synthetically from pure benzol, involving an additional large consumption of sulphuric acid and of caustic alkalies, and an extensive mechanical plant. The current supply of benzol and toluol—important hydrocarbons found among the multitude of products formed in the distillation of coal—was, however, far from meeting this new demand. At once recovery devices were installed in connection with many of our great coke plants, and the two valuable products were carefully separated and collected, instead of being wasted in the air, or used as fuel.

At the close of the war all of the newly organized works now devoted to making explosives will be idle. Their initial cost has, however, been amply covered by the high prices paid for the products, and they remain in perfect condition to resume operations in case our Government must engage in warfare—another national asset in the line of "preparedness."

Increased plant for the manufacture of the two acids mentioned above would inevitably be necessary at an early date, under normal circumstances, to meet the wants of our steadily expanding chemical industry, especially for use in making fertilizers. The forcible utilization of the by-products of our coke works is, however, an economic gain of prime importance. The end of the war will find us in a position to supply all of the crude material needed in the manufacture of such artificial dye-stuffs as the country has hitherto imported from Europe, and in the preparation of a variety of medicinal and allied compounds, for which we have also depended upon foreign sources.

The manufacture of automobiles, especially of motor trucks, to fill foreign orders has received a powerful impulse. In May, 1914, the value of such exports was $2,985,000. In May, 1915, it reached $10,555,000. We shipped 663 automobiles to Great Britain in May, 1914. The number grew to 4,036 in May, 1915

This has necessarily required notable additions to plants; but not more, probably, than the natural growth of the industry would have demanded in the course of the next two or three years. The value and efficiency of the American auto, under conditions of the most exacting nature, have, however, been abundantly demonstrated throughout Europe, and this advertising on a vast scale, by way of first-hand demonstration, will certainly prove to be an exceptional aid in enlarging the European market for American cars.

A review of the chief industries, ministering particularly to the temporary needs of the belligerents across the Atlantic, shows clearly that the final outcome will be a very material addition to the manufacturing plant of the United States. Part of this plant will be simply anticipatory of the normal growth of the country's mechanical equipment; part must lie idle in time of peace, but is a distinct asset in the national preparation for an adequate defense against attack; the remainder furnishes at once products needed in the healthful expansion of our chemical industry.

Less conspicuous and spectacular, but of far greater permanent value, is the impulse given to the manufacture on American soil, with American raw materials, of a variety of articles, for which we have hitherto been dependent upon foreign skill and enterprise. In a more or less uncomfortable way, we have suddenly been brought to recognize the unwisdom, the folly, of shipping vast amounts of the crude material of our farms, forests and mines, three thousand miles across the ocean and buying it back in a manufactured form at a vastly enhanced price. We have likewise come to recognize the absurdity of allowing many natural products of the tropics, of South America, of the Far East, to find their way to Europe, and of paying foreign intelligence and skill to transform them into articles of daily need in our lives.

The complete cessation of imports from Germany and Austria, and the serious restriction in our purchases from many other countries, have taught us these two lessons. It is in the practical application of these lessons that the American people will derive its chief benefit from this otherwise so deplorable world conflict. American skill, ingenuity, adaptation, inventive talent, scientific attainments, and general enterprise have promptly rallied to meet widespread demands, and establish on our own soil the permanent manufacture of a number of wares, some of minor, others of major importance. The return of peace will see them well rooted and able to withstand foreign competition.

I might briefly cite a few illustrative instances.

The curved faces of our clocks and watches have for many years come to us exclusively from Germany. Last autumn, the imports ceased. Manufacturers of time-pieces laid their needs before leading American glassmakers. Within a month the problem was solved. The curved disks were made a regular article of manufacture, and the quality was beyond criticism. A second month passed, and the cost of production was reduced to a figure below the former current prices of German manufacturers.

Another case. There is a large consumption in this country of small, fine brushes, for water colors. The supply was entirely of German origin. It suddenly ceased. Promptly an American firm started the manufacture. It was found that the essential raw material consisted of fine hairs from the inside of the ears of cattle. German makers secured their supplies from the slaughter houses of Chicago. The steers of the Western plains will henceforth contribute their quota to American artistic activity without any necessity that it should make a double trip across the Atlantic.

Barium minerals are unusually abundant in the United States. Yet, we have imported in the past over 17,000,000 pounds annually of the various barium salts required in the arts. During the past twelve months one establishment has introduced the manufacture on a large scale of the chloride, carbonate, etc., from domestic raw material, and another will soon begin operations. Both utilize the vast deposits of barytes in Tennessee, Georgia, and North Carolina.

(To be continued.)

Two Controls for Automobiles.—Clark T. Henderson of Milwaukee, assignor to the Cutler Hammer Mfg. Company, has secured patent No. 1,143,195 for an automobile in which two driving seats and duplex control for each of the seats is provided, so that the operator may sit on the front or rear seat as desired and operate the machine from either seat. The front seat is movable so that it can be shifted out of the way when the driver is operating from the rear seat. This movable front seat, when in driving position, covers the foot lever of the control of the rear seat. Hence, the foot lever is not accessible to those on the rear seat, thereby avoiding interference with the control by the use of the rear lever when the chauffeur is operating from the front.

Where Wings Are Made for Fighting Men

How the War Has Stimulated the Aeroplane Industry in This Country

By Frederick Eppelsheimer

THANKS to several European governments, the United States has recently acquired an aeroplane industry worthy of the name. A year ago it is doubtful if all of the factories in the country could have produced 100 aeroplanes in twelve months. Now, at a pinch, they might turn out that number in a week, or an air fleet of 5,000 in a year.

One big company alone that has expanded enormously in the last year is building biplanes, hydro-aeroplanes and flying boats at the rate of twelve every day. Practically all of its output goes abroad, but in the day of national need the departure of the winged craft that never return can be stopped by embargo, and the constructive facilities thereafter utilized for America's Army and Navy.

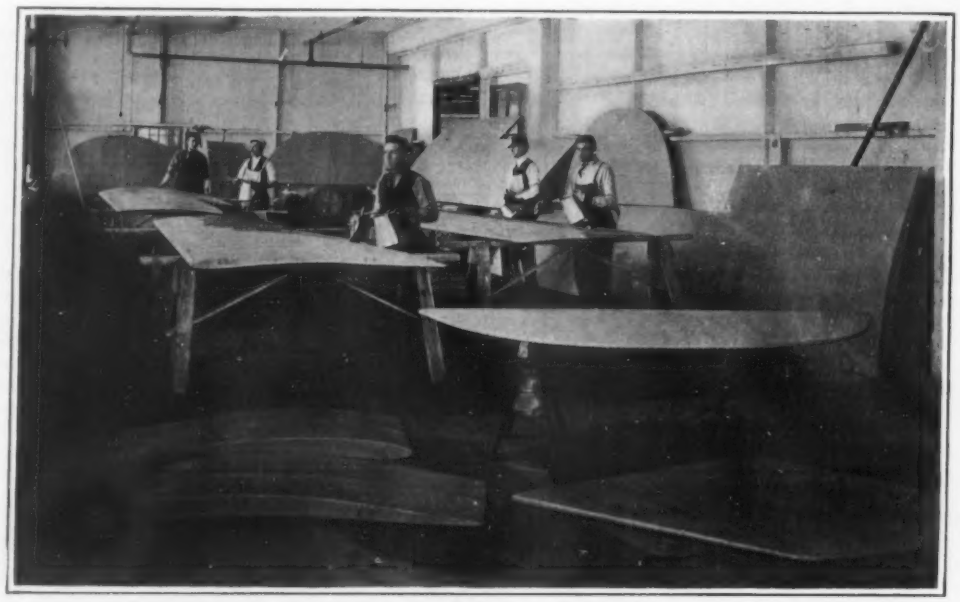
Glenn H. Curtiss, inventor of the marine aeroplane, is the head of the largest of the aeroplane plants, supplying about eighty per cent of the country's present production. There are smaller works under the direction of W. T. Thomas and his brother, O. W. Thomas, at Ithaca, N. Y.; those of W. Starling Burgess, noted also as a yacht builder, at Marblehead, Mass., and of Glenn L. Martin at Los Angeles, Cal. All participate in the export of flying machines. In addition a big aeroplane motor plant—the Sturtevant—has been developed near Boston, and at present writing is producing four engines per day. Further extension is expected to increase its product to ten motors a day by September 1st. This increase in the engine production may further expand the aeroplane industry in this country, which has been retarded by the lack of motors.

All of the aeroplane plants mentioned are producing craft of the biplane type first flown by the Wright brothers. The monoplane seems almost to have passed so far as military use is concerned. Louis Blériot, its inventor, is building biplanes as a French army constructor. In Germany, as in France and England, the monoplane is reported displaced by the bipiane for military use. This is due to the better view of the earth afforded to the scout from the biplane, and to the greater strength of its bridge truss structure which is required to lift heavier and heavier loads of bombs and fuel, extending the aircraft's radius of action and aggressive power. It is fair to recall here, however, that a monoplane of somewhat unusual type, the Morane "parasol," was used by Lieut. R. A. D. Warner in his successful attack on a Zeppelin above Antwerp.

The ability of Mr. Curtiss to fill big foreign orders has been due to the fact that he developed a motor factory along with his aeroplanes. Nearly all of his rivals have depended on buying motors to put into their machines, consequently when the war orders arrived and they tried to obtain such efficient motors as were acceptable to the Allies' purchasing agents, they found that the output for many months ahead had already been bought up for the use of foreign armies.

One reason for the purchase of so many motors is the need of spare engines to replace those which are rapidly worn out under the strain of active service. The contracts usually call for the delivery of a spare engine with each flying machine. The total value of the orders placed in this country by European powers since the beginning of the war is estimated by a competent authority at $8,000,000.

When the war began, Mr. Curtiss was building about one aeroplane a week at his little factory in Hammondsport, N. Y. His first important sale was that of the "America," the big flying boat built for the Rodman Wanamaker transatlantic attempt. Though discarded for oversea flight, she proved so successful as a naval flyer that the Admiralty ordered thirty-two of her class. Many of these have been delivered and are in service on the English coast. Besides these orders there came others for hundreds of smaller flying boats, hydro-aeroplanes and for tractor biplanes with wheeled landing gear for the use of the allied armies.



Varnishing aeroplane wings in the "dope room."

Putting together the framing for the wing panels.

The decision of William J. Bryan as Secretary of State that an aeroplane was not a ship within the meaning of international agreements, and that contrary to the German contention it might be exported, placed the entire industry on a firm basis and brought capital to its aid. In the process of expansion that followed, the Hammondsport factory was turned into a motor works, and the Curtiss flying gear was built entirely in new factories established at Buffalo and Toronto, supplemented by a boat yard at Tonawanda, and other outside factories that made small metal parts for a time. Another large motor factory was added to the plant at Buffalo, making eight large buildings there.

The location of the two motor works in this country keeps the control of the Canadian works here also, it will be noticed, as Canada produces no engines for the flying machines made there.

Besides the aeroplane plant in Toronto, Mr. Curtiss has established a school there, which is training ten young men each month for service as pilots in the British army and navy. They are taught to fly either the landing biplane or the flying boat as they select. A

Planing and finishing aeroplane propellers.

giant experimental biplane of the land type is being constructed at the Toronto factory. This is the largest ever attempted in this country or England for military or other purposes. It will have two engines of 160 horse-power each, and a spread of wings of nearly 100 feet. At the Buffalo plant two other experimental machines of great interest are being built for the Russian navy. These will have as much power as the big British biplane, but will be of smaller size, about seventy-four feet across the wings. With less resisting surface they are expected to have higher speed, while also lifting a bigger load than any of the craft now in use.

Ithaca, N. Y., has become an aviation center of importance as one of the results of the European war. The Thomas brothers, who have established the industry there, had been engaged in building biplanes and flying boats in a small way at Bath, N. Y., for several years before the war. They were fortunate to obtain at the outset of the conflict the services of Douglas Thomas, a young English designer not related to them. He had been associated with the construction of the noted Sopwith biplane in England, the speediest biplane ever built, and had come to this country to work on the transatlantic "America."

With his aid the Thomas plant soon turned out a fast biplane of the military tractor type, carrying three men and four hours fuel. With this load the aeroplane at a trial in February rose 4,000 feet in ten minutes. The builders, with the prospect of war orders in sight, had determined to expand, and acquired a large factory at Ithaca, where they erected more buildings. They received from the allied powers a preliminary order for twenty-four of the new machines, and these proving satisfactory, other orders for a large number followed. In addition the United States Navy gave an order to the company for two hydro-aeroplanes for its new training squadrons, each to have motors of 140 horse-power.

The size of the motors shows one of the lessons of the war and America's response to it. A year ago the Navy could not find a motor of even 100 horse-power to meet its needs. Now they are being turned out in large quantities in this country and shipped to Europe. More lift, more speed and more power have been the demands constantly coming from the battlefields abroad.

About four aeroplanes a week are being completed at the Thomas plant, and the orders received from the Allies will keep the factory running for the remainder of the year. In addition, a class of patriotic young Canadians is receiving flying lessons, in preparation for service as aeroplane pilots in the Royal Flying Corps and the Royal Naval Air Service. These young men receive commissions as lieutenants and an allowance of $375 for the expense of their training when they pass the British government tests for pilots.

W. Starling Burgess long ago established a reputation as a pioneer in the aviation industry, being the first to recognize the claims of the Wrights and to build under their patents. Like the Thomas works, his factory at Marblehead, Mass., has been expanded on large orders from the representatives of the allied powers, and he is erecting an addition to the plant, at Lynn, Mass. The present capacity is about four aeroplanes a week, and Mr. Burgess has all that he can do for this year. He is using Sturtevant and Curtiss motors, and besides the craft for Europe is supplying two hydro-aeroplanes to the United States Navy. All the machines are of the biplane type of wings. Both land and water flying machines are going to the Allies.

Out on the Pacific Coast the name of Glenn L. Martin is famous as an aviator who has developed an aeroplane that has given good service to the United States Army and has achieved several notable records in performance. Holland, stirred by its precarious position in the European struggle, determined recently to strengthen its aerial forces. Six hydro-aeroplanes to be stationed in its East Indian colony of Java were ordered from Mr. Martin, whose factory is at Los Angeles. He is also enlarging his plant and has received orders for at least thirty-five machines from the Allies.

Several other constructors have shown sample machines, which in the usual duration test of four hours have given satisfactory results to the flying inspectors from abroad, and have received orders contingent on obtaining enough engines of approved type. With motor works being enlarged to meet these demands and twenty-two builders developing aeroplane engines of high power, including the Burgess, Thomas and Martin works, it seems sure that the wheels of the industry soon will be greatly multiplied. Among the machines that have met approval are those built by Howard Huntington at Hempstead, L. I.; Heinrich brothers of Baldwin, L. I.; Silas Christoferson of San Francisco, and Maximilian Schmitt of Paterson, N. J.

Final assembly of the boat-body, wings and power plant.

Saving the Grease in Sewage

ONE of the things that makes sewage difficult to handle is the amount of oil and grease of various sorts which it contains. In some cities this is present in large quantities owing to the nature of the prevailing industries, but it constitutes a considerable percentage of all sewage. German scientists who have been studying this question estimate that in Germany there is an average of 10 grammes of fatty matter per capita, flowing each day into the drains, an amount which is worth in the aggregate no less than the enormous sum of 59 million marks. Obviously, if this waste grease could be recovered there would result an enormous saving of expense and a tremendous diminution of imports of such materials, and this is, of course, a highly important consideration during the present war. This problem has been very satisfactorily solved by a process devised by Prof. Bechhold of Frankfort, who has been working on it since the 90's, according to the *Chemiker Zeitung* (Berlin).

When liquid sewage is allowed to rest in settling basins the greater part of the content of fat is found in the greasy sediment or slime which collects on the bottom of the basins. In the larger German cities this slime contains an average of 17 per cent of grease, while in certain places this percentage is very much higher. In such an industrial center as the English town of Bradford, for instance, which contains many wool-washing companies, it runs as high as 40 per cent.

In Prof. Bechhold's experimental plant in Frankfort the watery slime was treated with a fat solvent at a temperature of 100 deg. Cent. On being deprived of its grease the slime is easily dried by pressure. Before being "defatted," however, the slime retains its moisture very stubbornly because of its colloidal properties. Thus two birds are killed with one stone. The recovered grease is very valuable on the one hand, and on the other the dried slime is easily disposed of. Moreover, it also possesses economic value. So this greasy slime becomes a source of revenue, instead of a source of expense, as it formerly was because of the difficulty of drying it so as to handle it readily.

The results of the Frankfort experimental plant were, in fact, so satisfactory as to lead to the formation of a "Consortium for the Utilization of City Sewage." Just before the outbreak of the war the programme of this consortium, namely, to get rid of the slime and to extract all its economic value, was set in operation in a new and large plant in Buchenhofen, near Elberfeld.

By Prof. Bechhold's process there is obtained a black crude fat, which is separated by distillation into 50 per cent of solid stearin and 50 per cent liquid oils. The residuum of distillation is a pitch which can be utilized as an isolation medium, a lubricating medium, etc. The slime can also be used as a fertilizer since it contains 3.2 per cent of nitrogen. When burnt it has a certain amount of heating value and yields a slag which can be employed for road building and possibly to make artificial stone.

Multiplex-cylinder Motors

ONE of the troubles expected from the introduction of multiplex-cylinder motors for automobiles so far has not materialized—the incompetent repair man. There are thousands of mechanics, so called, in the United States, who up to the present have not had an opportunity to tinker with an eight- or twelve-cylinder motor, despite the fact that eight-cylinder cars are now a year old. It was generally feared, even by the manufacturers of these cars, that bungling garagemen or blacksmiths would succeed in ruining motors with such thoroughness as to create a prejudice against them among the general motoring public. A disappointed owner of a novel type of car can do a great deal of harm by voluble and continued complaint.

The multiplex motor has shown that whatever may be its drawbacks in the multiplication of cylinder and piston parts, valves, spark plugs and wrist pins, it has also a great many advantages directly due to this very multiplication. Not alone in the sense of smoother running and noiseless operation, as far as these affect the pleasure of the passengers and the comfort of the driver, because these were naturally self-understood; but in the sense of freedom from frequent repairs. The motorist who has fretted and fumbled with eight valves, on a four-cylinder motor, trying to regrind and reseat them properly, had a veritable nightmare imagining himself performing a similar feat on a twelve-cylinder V-type engine, with its twenty-four valves.

The pressure in a large cylinder; the strains put on the pistons, rings, wrist pins, crankshaft; the quantity of partly burnt gas and consequent carbonization; the force with which the intake and exhaust valves are returned to their seats and held in position at the moment of the explosion—all these are considerably reduced in the multiplex-cylinder engine, with the result that the wear and tear on each of the parts is so much smaller as to more than make up for the multiplication of the parts. In other words, a well-built multiplex-cylinder engine, properly balanced and lubricated, will require little attention and little overhauling.

Indian Music

THE last report of the Smithsonian Institution records the recent progress of Miss Frances Densmore's well-known studies of the music of the American Indians. She had, at the date of the report, completed the field work for a large volume on Sioux music, including ninety-eight musical transcriptions of songs. It is interesting to learn that musical composers are now making free use of the material collected by Miss Densmore. The report mentions four songs, published by the Bureau of Ethnology, which have been adapted for orchestral purposes, and several others that have been arranged by various composers for one or more voices, for the violin, etc. Lastly, one composer is utilizing these aboriginal themes in an Indian opera.

Drug Addiction in the United States

THIS subject has been much discussed since the Harrison law went into effect, and many exaggerated and misleading statements in regard to it have been published. A timely paper by M. I. Wilbert of the U. S. Public Health Service, on "The Number and Kind of Drug Addicts," has recently appeared in the *Public Health Reports*. It was generally predicted that the result of the enforcement of the federal anti-narcotic law would be the besieging of hospitals by drug addicts and a crime wave of national scope, accompanied by a trail of suicide and death. Although hospital reports clearly show an effect of the enforcement of the law, these dire predictions have by no means been verified. After a careful review of various evidence, including especially statistics as to the total amount of narcotic drugs available for all purposes, legitimate and otherwise, Mr. Wilbert concludes that the estimate made by the committee of the American Pharmaceutical Association some years ago that the drug addicts in this country do not number more than 200,000, is approximately correct even at the present time.

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One wonders what on earth any government can do with thirteen million dollars worth of automobiles even in war times, yet automobiles to this enormous amount have thus far been furnished to Russia. In order to facilitate the shipment of the trucks, one shipper has a day and night shift working on his piers, where all the autos and their parts are assembled for shipment. He has his own wood-working plant with about 2,000,000 feet of lumber on hand. The J. G. Brill Company, the Philadelphia car builders, are kept busy working overtime to make the bodies for the trucks. Not an unusual sight is a dozen or so freighters each with a capacity of thirty-six cars going down the Hudson River laden with their quota of trucks for the Russian government.

Shipping $13,000,000 worth of automobiles to Russia for army purposes.

Influence of the War on the Automobile Industry

What It Was Expected to Be, What It Has Been, and What It is Likely to Be

By H. W. Perry

WHOLLY unexpected results have been produced on the American automobile industry during the first year of the European war. It was reasonable to suppose that a conflict involving all the great nations of Europe, with the consequent disturbance of world commerce and finance—the declaration of moratoria and long lists of contraband of war embracing automobiles and motor trucks, the seizure of cargoes of American cotton, wheat and other products, the closing of stock exchanges and the enormous increases in ocean freight rates and insurance—would affect the automobile industry most adversely, if not disastrously.

Such was the general opinion even among the leaders of the industry during the first few months following the outbreak of the war, and the fear was in no wise allayed by the proposal of the American Government to place an emergency revenue tax of fifty cents per horse-power on the manufacture and sale of motor vehicles, or, as an alternative, to tax the manufacture of gasoline at two cents a gallon.

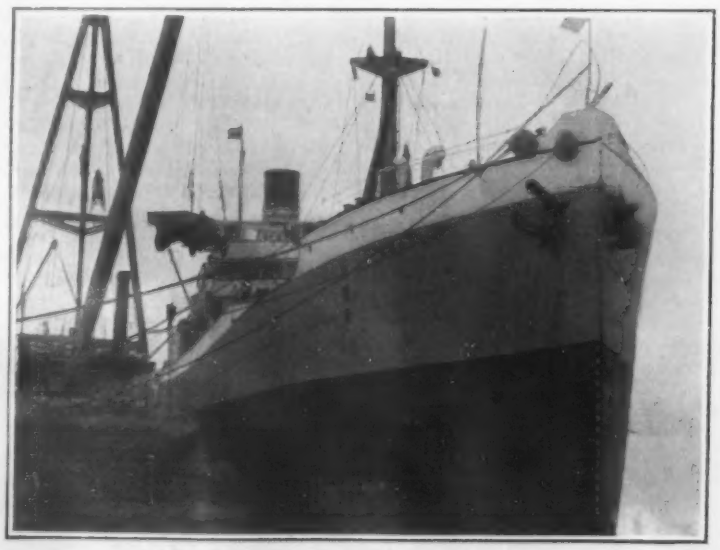
Fortunately for the industry, and for the owners of two million motor vehicles now operating in the United States, this additional burden to the many imposed by State and municipal authorities was escaped by the decision of Congress to omit both motor vehicles and gasoline from the emergency revenue act.

During the first few months of the war—from July to October last year—the pessimistic expectations of the automobile trade, in common with most other lines of industry in the country, were largely realized. Exports of automobiles, which during the first six months of the year had amounted to about $2,750,000 a month and promised to continue to do so, suddenly dropped to a little more than half a million in August and less than $900,000 in September. At the same time a shadow was cast over the outlook for domestic sales by the general business uncertainty created by the war and its first far-reaching effects.

The automobile trade gathered what comfort it could from the probability that the record grain crops of the far West would enable farmers to continue their growing purchases of passenger cars, that South America, South Africa, India, Australia, New Zealand, and other countries remote from the seat of conflict, finding their usual European sources of supply cut off, would turn to the United States for their automobiles in course of time and that the destruction of European automobiles and motor trucks in army service and the widespread purchase of horses in great numbers would create an unprecedented and permanent market for motor vehicles after peace was declared—whenever that might be. Such comfort, however, appeared to be of the kind to be enjoyed mainly in anticipation; it seemed to promise little for the 1915 selling season.

It will be understood, then, that the surprise and joy of the automobile trade were like those of the man who finds a $5 bill in a last summer suit, when orders for motor trucks by the hundred came pouring in from the European governments in the early fall and dealers' estimates of requirements far in excess of all precedents, particularly from the west, were received in the late fall and early winter.

What the actual effect of the war has been is best told by figures. The accompanying table showing exports for nine months ending with last June (the latest obtainable at time of writing) shows the rapid growth from month to month until they exceeded $13,000,000 in the single month of June. This rapid increase is due almost entirely to the purchase of motor trucks by the Allies—England, France and Russia—as shown by the table of exports of commercial vehicles during the last two fiscal years. Shipments of trucks on war orders began last September. For more than a year before that the average shipments of trucks from America was 65 a month. In September they doubled, and from then on increased amazingly, until in June they totaled nearly 3,000.



Loading automobiles on a Japanese ship for Russia.

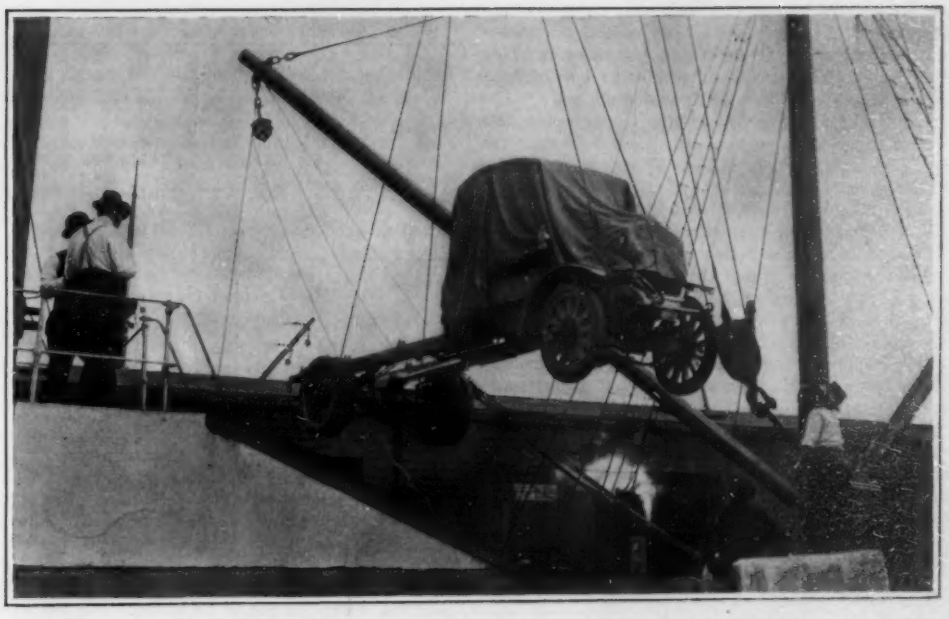
At the same time, the average value of the vehicles almost doubled, from $1,500 during the fiscal year ended June, 1914, to nearly $3,000 in the last fiscal year. The significance of this is that before the war the few commercial cars exported were many of them small delivery wagons and low-priced trucks, but when the foreign governments turned to America to augment their transport systems, they placed their orders for the very best the market afforded, and mostly for three-ton and five-ton trucks, with a limited number of 1½-ton machines. The countries

at war were able to fill their requirements for officers' cars by requisitioning touring cars made and owned at home, and their citizens did not wish to import American passenger cars to replace them, even if they had cared to spend the money, fearing they also would be commandeered. Uncertainty and bad financial conditions in many other countries prevented the usual purchase of American automobiles, with the result that exports of passenger cars dropped suddenly from 1,936, worth $1,874,312, in August, 1913, to 385, worth only $441,879, last August. Since then there has been a rapid recovery, until in May last, a new record of 4,812 cars, worth $3,971,483, was established. However, the total exports of passenger cars for the last fiscal year is more than $4,000,000 less than in the previous year, whereas truck exports increased more than thirty-three fold in value and exceeded the passenger car exports by more than 50 per cent in value.

The table of exports by countries shows how exports to Germany dropped from more than $1,000,000 to $20,000 in the year, while those to France grew thirteen fold, those to Great Britain were tripled, and those to all other European countries combined, except Italy, were more than trebled.

South America, instead of becoming a better customer, reduced her purchases from upward of $2,000,000 to a little over half a million. Even Canada, the second best customer we had, cut her American automobile bill by nearly a million and a half.

The immediate effect of the war orders for trucks was to give a renewed impetus to the truck business, which had been in a depressed state for more than a year. Factories began working eighteen and even twenty-four hours a day. Old stock was promptly cleaned up and new and improved models brought out last winter and spring, of which the nations at war and our own home market are now enjoying the benefit. In many cases, list prices have been reduced on the new models, in which worm drive has nearly supplanted the old side-chain drive.



A motor truck on its way to Europe. America's sales of automobiles exceeded $13,000,000 in the month of June, which huge sum was spent chiefly for motor trucks.

A line of chassis awaiting shipment to Europe. The average value of vehicles almost doubled from $1,500 in 1914 to nearly $3,000 in 1915.

The effect of the war on domestic purchases of motor cars is not so easily determined, because no one knows what the home demand would have been had war not occurred in Europe. Doubtless there would have been a normal increase of 20 to 25 per cent in the sales, as the average increase for the four years from 1910 to 1914, inclusive, had been nearly 40 per cent. The increase in 1914 over 1913 was only about 10 per cent, owing to dull times in trade generally.

A year ago hardly anybody in the industry anticipated the real boom that has been realized. Reports of sales for the fiscal year ended June 30th last, show a total of 700,000 passenger cars and commercial vehicles produced in the United States as compared with 515,000 the year before. This is an increase of nearly 50 per cent. The value of the year's sales totaled about $520,000,000 as against about $420,000,000 in the preceding twelve months—a round gain of $100,000,000.

During the first six months of this year the railroads shipped 94,678 freight cars of motor vehicles, as compared with 70,613 in the first half of last year—an increase of more than one third in volume.

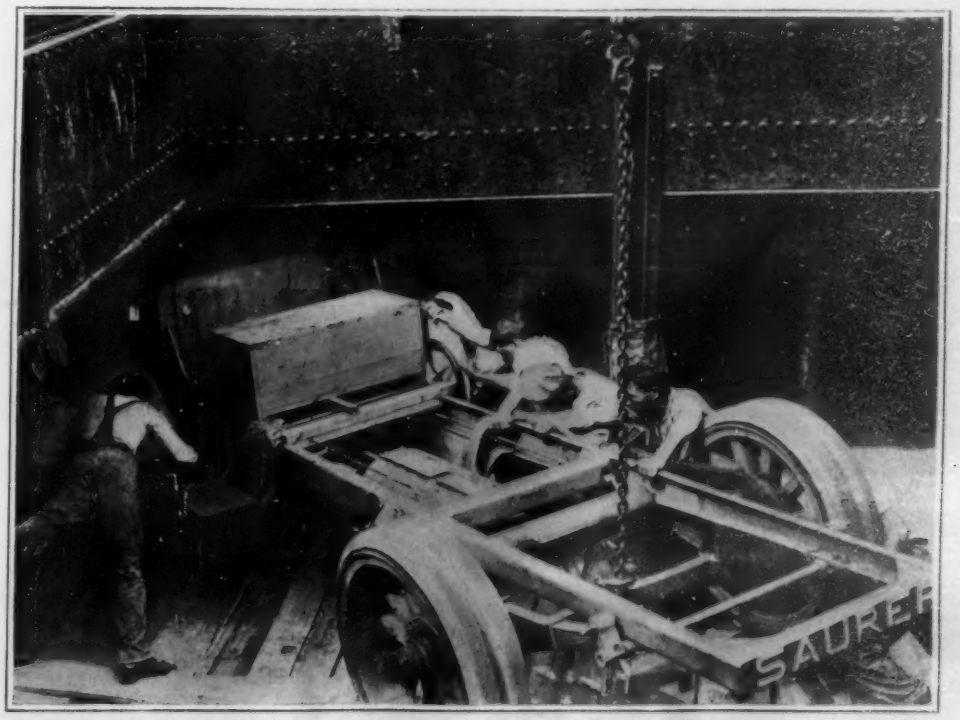
Most of the largest manufacturers have already announced preparations to increase their production greatly during the coming season as the prospects for the next selling season are better than ever before. An output of upward of a million cars in the next fiscal year would not be surprising. The limiting factor is likely to be difficulty in securing sufficient material.

Manufacturers are looking to the middle west and far west for the largest increase in sales, because the farmers have prospered during the past year as never before. The source of most of their wealth last winter was the combination of record-breaking crops and an unprecedented foreign demand at high prices. The 1914 wheat crop was more than 147 million bushels larger than the crop of 1913, which was itself bigger than in any previous year. Most of this crop of 911 million bushels was worth a dollar a bushel to the farmer. The corn crop was largely in excess of 2½ billion bushels, and there were large increases also in oats, barley, rye and other grains.

More than 420 million bushels of the five chief breadstuffs, worth a total of $440,537,000, were exported during the eleven months ended with last May, which was more than four times the quantity and nearly five times the value of corresponding exports in the eleven months ended with May, 1914. Exports of horses during the last fiscal year aggregated $64,000,000 as compared with $2,400,000 in the preceding fiscal year.

So the Western farmer had plenty of money to spend for automobiles, and the harvesting of another record-breaking wheat crop this summer, with prospects of a corn crop equal to that of last year, promises further increased prosperity.

The big volume of business done by the leading automobile companies the past year enabled them to cut



Stowing away an American chassis in the hold of a ship. In one month nearly 3,000 motor trucks were shipped to the scene of war.

down manufacturing costs so much that they made big reductions in list prices on the new models for 1916—cuts of as much as 20 to 40 per cent in some cases. This will induce the purchase of automobiles by tens of thousands of new buyers, both at home and abroad.

Considering all present conditions, the automobile trade is expected to be very much greater during the coming season than ever before. If war continues for another year or two, the exports of trucks, foodstuffs and munitions will continue also. If it ends suddenly, a great period of reconstruction will ensue in Europe, exports of cotton and other raw and manufactured products will increase, and there will be a big foreign demand for American automobiles and commercial vehicles to replace those used in the war and fill the deficiency caused by all the foreign factories being kept so busy supplying the armies that they could not fill private orders or take care of their usual export trade, even if there were no embargo on motor vehicles.

The automobile industry seems to bear a charmed existence that is invulnerable to panics, hard times and war. There never has been a year since its inception when production and sales have not been greater than the year before.

MOTOR VEHICLE EXPORTS FOR NINE MONTHS.

	Number.	Value.
1914.		
October	1,404	$2,965,351
November	1,618	2,879,177
December	2,576	4,386,427
1915.		
January	2,738	3,858,680
February	3,232	4,807,812
March	3,768	6,683,865
April	5,345	8,045,222
May	7,247	10,555,395
June	7,408	13,364,800
Totals	35,336	$57,546,729

EXPORTS OF MOTOR VEHICLES BY COUNTRIES.
PASSENGER AND COMMERCIAL VEHICLES.
Eleven Months Ended May 31st.

Country.	1914.		1915.	
	Number.	Value.	Number.	Value.
France	1,286	$835,256	4,472	$11,142,414
Germany	1,391	1,003,000	20	20,164
United Kingdom	6,982	5,613,853	11,688	16,736,165
Italy	326	228,894	111	75,372
Other Europe	2,686	2,133,917	2,817	7,768,101
Canada	4,111	5,277,753	3,606	3,796,729
Mexico	164	252,098	67	68,067
West Indies and Bermuda	491	468,467	1,383	827,989
South America	1,909	1,888,529	1,071	583,119
British Oceania	3,819	3,325,902	2,727	2,271,349
Asia and Other Oceania	1,993	1,927,157	1,581	2,708,004
Other Countries	1,860	1,628,610	925	892,362

EXPORTS OF PASSENGER AUTOMOBILES DURING LAST TWO FISCAL YEARS.

	1913–14		1914–15.	
	Number.	Value.	Number.	Value.
July	1,720	$1,630,641	1,265	$1,143,419
August	1,936	1,874,312	385	441,879
September	1,711	1,456,322	646	597,904
October	1,697	1,663,716	732	678,387
November	1,707	1,676,726	776	634,659
December	2,301	2,052,484	1,297	998,698
January	2,481	2,174,392	1,803	1,313,153
February	2,837	2,378,494	2,230	1,785,330
March	3,538	2,984,915	2,429	1,958,302
April	3,239	2,760,478	3,078	2,804,741
May	3,157	2,857,601	4,821	3,971,483
June	1,982	1,870,882	4,418	4,785,998
Totals	28,306	$25,390,963	23,880	$21,113,953

EXPORTS OF COMMERCIAL MOTOR VEHICLES DURING LAST TWO FISCAL YEARS.

	1913–14.		1914–15.	
	Number.	Value.	Number.	Value.
July	44	$103,612	50	$106,400
August	68	109,437	66	124,016
September	48	91,054	128	294,288
October	79	129,506	672	2,286,964
November	64	105,501	842	2,244,518
December	88	100,660	1,279	3,387,729
January	45	74,491	935	2,545,527
February	57	83,461	1,002	3,022,482
March	50	63,932	1,339	4,725,563
April	52	72,676	2,367	5,240,481
May	99	127,024	2,426	6,583,912
June	90	120,357	2,900	8,578,802
Totals	784	$1,181,611	13,996	$39,140,682

INCREASED EXPORTS OF CEREALS.
Eleven Months Ended May 31st.

	1914.	1915.
Wheat	$80,871,055	$320,645,158
Oats	663,261	51,710,394
Corn	6,283,264	36,097,268
Barley	4,061,784	17,533,866
Rye	1,148,797	14,550,555
Totals	$93,028,161	$440,537,241

The Current Supplement

WITH the renewed attention being given to our Navy, the views in the current issue of the SCIENTIFIC AMERICAN SUPPLEMENT, No. 2070, for September 4th, 1915, showing some of the big cranes in the German shipyards, where war vessels are built, will be timely. Radio-telegraphy is so successful, and is so widely used, that many are asking why this method of communication has not been adapted to the telephone, especially as many reports have appeared in the daily papers telling of the excellent results that have been attained in experiments. The article on Radio-telephony in this issue by a recognized expert throws much light on the question, and points out some of the problems and the difficulties yet to be solved. The key to modern warfare is undoubtedly the explosive, as it is essential not only to the use of the rifle of the soldier, but for the immense siege gun, which has been the sensation of the present conflict, as well. It is also the heart of the shells thrown by these giants, without which their efforts would be of little avail, not to speak of the numerous forms of bombs and grenades. It is, therefore, necessary to an understanding of the present contest in Europe to know something about what these explosives are and what they do, for there are a large number of different kinds in use. Such a knowledge is also desirable for appreciating the value of the many reports of new and wonderful explosives that so frequently appear. The article on Military Explosives, the first installment of which appears in the present issue of the SUPPLEMENT, contains the most comprehensive information yet published. Many descriptions of the marine torpedo have been published, but there are many points about its operation that have not been told—how it is built, how it is launched, and how it is steered and controlled. All of these points, as well as others of equal importance, are excellently described and illustrated in this issue. The Jitney has become a most important, and also a very disturbing, element in many cities as regards street railway transportation, and the discussion of the problem by an electrical railway expert, with a consideration of how the railways can meet the competition, is a timely contribution. In many manufacturing operations heat temperatures are being employed of such a degree, and under such conditions, that the ordinary thermometer is useless, and yet it is absolutely necessary in these processes to know and control the temperatures. For such work the pyrometer has come widely into use, and many forms have been developed. There is an interesting article on the Principles Governing the Design and Construction of Electrical Pyrometers that should be of great value to many readers, both scientific and practical. The Bacterial Flora of Trees and Men gives a most interesting account of some bacilli to which but little attention has heretofore been given.

Concerning Leprosy

THERE was a time when we of the western world never worried much over leprosy, the malady which medical men refer to as the "dean of diseases." Leprosy was confined to countries where it had existed for centuries. But when military conquests took us into distant lands where the dread disease exists, our medical men at once took up the seemingly hopeless task of finding a cure for it. We were not content to herd the lepers together and let them die without some show of salvation. And now, after thousands of years of unabated existence, leprosy is about to meet its Waterloo. Indeed, it already has.

Lepers are numerous in our Pacific possessions, Hawaii and the Philippines. Ever since we occupied these empires our doctors and scientists have been doggedly on the trail of causes and cures. Before we took over these new possessions the lepers were permitted to roam about pretty much at will. Now those in the Philippines are confined at Culion leper colony, and those in Hawaii are shut away from the world at Molokai.

Complete cures of leprosy have been made in Manila in the cases of a young native boy and a girl discharged from San Lazaro Hospital. These children had suffered from the disease for years, but within a year after treatment was begun all leprous signs had disappeared. But to make sure of the efficacy of the cure the patients were held two years longer, and then they were given their freedom to go among clean men and women.

The drug that is said to have helped most in the treatment is said to be oil from the chaulmooga tree, which thrives in India. Thus, where leprosy flourished the most in past ages, right there was the means of a cure. The chaulmooga tree also grows in parts of South America. The oil of the tree has been used for years as a blood purifier, but it remained for Drs. Heiser and Goff, Americans in the Philippines, collaborating with a Filipino physician, to claim the distinction of the first cure.

Cures have also been effected by American medical men at Molokai, in Hawaii, and the decided success of our scientists there, among them a Dr. Wayson of Port Townsend, Wash., has led British surgeons to take up a similar line of treatment for leprous patients in India. An English doctor claims to have cured four patients with a vaccine, the nature of which he has not, so far as known, disclosed to science. Another cure is claimed by a Swiss scientist in using liquefied air. Carbon dioxide, applied locally, is said to destroy the germs in the flesh. But the most pronounced and most satisfactory of all the cures seem to be those effected in Manila.

Leprosy holds terrors that consumption is wholly free from. Its victim exists in a living hell, robbed of the companionship of family and friends. But in some ways leprosy is not the monster that the white plague is. Once possibly contagious, it is no longer so. Lepers confined in our colonies in the Philippines and Hawaii, and probably those in this country, are permitted to marry and to bring forth young. Children may nurse from the breasts of leper mothers for a year or more, and still be taken away clean and unharmed.

Where there were upward of twelve hundred lepers in Hawaii when we took charge, now there is considerably less than half that number. This performance, on a magnified scale, we are repeating in the Philippines. In almost all large colonies the lepers are attended by Sisters of Charity, and those saintly women, once their lot is cast, never again return to the outside world.

A Chinaman first introduced leprosy in Hawaii. Cases of the disease have existed in Louisiana for some years, and perhaps our first leper colony was founded there. A few of our soldiers, returning from service abroad, have brought the disease home with them. No better use, it would seem, for the cures can be made than by giving these worthy men the benefit of all scientific research and laboratory experiment yields, no matter the expense.

There are a hundred school children in Hawaii whose parents are lepers at Molokai. Things are so congenial at the leper station that discharged cures have asked to be re-admitted. Hence, those cities which are now and then thrown into a panic through a report that a leper is at large in their midst need not worry for fear of getting it. Better worry over the case of measles next door. In China, if report be true, lepers are made to dig their own graves. Then bullets are sent speedily through their hearts. That's one way of ridding humanity of leprosy. But it isn't the American way.

Chemical and Physiological Studies of a Man Fasting Thirty-one Days

THE relations between disease and nutrition, and the nearly complete inanition observed in many cases, indicate the importance of studying the physiology and chemistry of fasting. In 1912, Francis G. Benedict of the Carnegie Institution of Washington, made a very complete study of a man fasting thirty-one days. In the *Proceedings* of the National Academy of Sciences, April, 1915, appears a short account of the work, which is published in full (416 pages) as Publication No. 203 of the Carnegie Institution of Washington.

Measurements were made of the weight, perspiration, temperature, pulse, blood pressure, respiration and alveolar air pressure. A complete clinical examination was made every second day. Complete chemical and microscopical examinations of the urine were made.

The respiration was studied in the respiration calorimeter, in which the carbon dioxide excretion, the oxygen consumption, and the water vaporized from lungs and skin could be measured simultaneously. The heat production was likewise measured, and the effect of change of posture and other factors upon the metabolism was studied. The metabolisms of the sleeping and the waking state were also compared. The energy transformation per kilogramme of weight and per square meter of surface was computed.

For thirty-one days the fasting man's normal condition remained fairly normal, despite great physical deterioration and a decline in weight from 133 to 104 pounds.

The subject, a native of Malta, insisted on breaking his fast with acid fruits in large quantities, thus inducing intestinal disorder, which necessitated a short sojourn in a hospital.

The Accuracy of Modern Rifles

By Edward C. Crossman

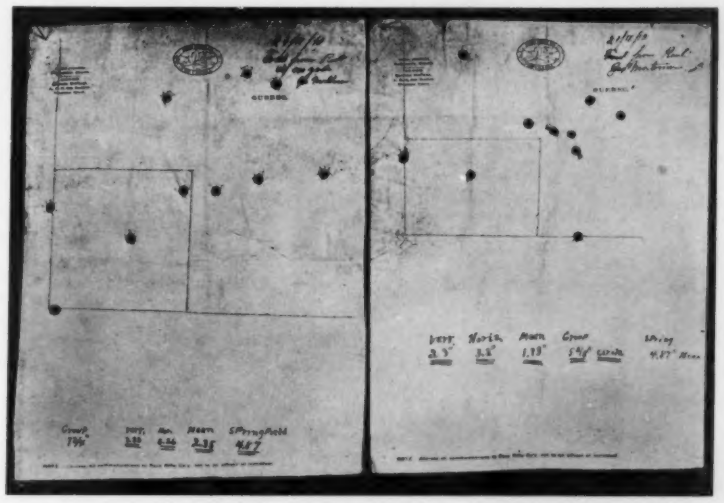
THE photograph shows an example of the accuracy of the modern rifle such as is now being used in the trenches of Europe.

The two groups were fired from a rifle of the same make as those now in the hands of the Canadians in France, but of a smaller caliber and higher speed.

Each one is fired on a standard-sized letterhead, which is 8½ by 11 inches, and over a range of 500 yards, five city blocks.

The first group, to the left, falls within a circle of 7¾ inches. The second goes into a circle of 5⅜ inches. Each group consists of ten consecutive shots.

The accuracy of the American army rifle is very close to this, the groups of ten shots over 500 yards of range averaging about 8 inches, and some of them, of course, being still smaller. In other words, the American service rifle will put ten shots well within a china dinner plate at the distance of five long city blocks.



Two groups of shots fired with a modern rifle, showing accuracy of fire.

Russian Naval Victory in the Baltic

PUBLIC interest has centered so largely in the operations of the allied fleets in the North Sea, around the British coasts and in the Mediterranean and Dardanelles, that the fact has been lost sight of that Russia possesses in the Baltic a fleet which, though numerically weak as modern fleets go, is yet a factor to be reckoned with in the general naval situation.

From time to time reports have come from the Baltic of minor operations in which the Russians have acquitted themselves so well as to warrant the belief that in the Russian navy a growth in *morale* and general efficiency has taken place since the Russo-Japanese war similar to the vast improvement which has been manifested in the Russian army.

By far the most important engagement in which the Russians have figured so far at sea is the recent successful repulse of the German attack in the Gulf of Riga, which was intended to assist the movement of the German left flank against Riga, which presumably has for its ultimate destination the capital at Petrograd.

The German expedition seems to have been a very formidable force and, judging from its composition, the plan would seem to have contemplated a combined attack by sea and land on the great port of Riga and the landing of considerable forces at Pernigel, on the east shore of the Gulf of Riga, forty-five miles to the north. Two days previous to the recent engagement, the invading fleet was reported to include nine battleships, twelve cruisers, and a large flotilla of destroyers and mine-sweepers. Just what portions of this fleet actually forced the entrance to the gulf and was engaged is not certain. Dispatches speak of the operations of the enemy being aided by fog, and the indications are that such losses as the Germans suffered were due to mines and submarines. According to the announcement made by M. Rodzianko, president of the Duma, when addressing that body, the Germans lost one battle-cruiser, the "Moltke"; three cruisers, and seven torpedo boats, and the attempted landing of troops at Pernigel was frustrated, the transports or "barges" with all their troops being captured. After its repulse, the German fleet retreated from the Gulf of Riga. The losses on the Russian side were two gunboats and one destroyer sunk and two destroyers damaged. By far the most important loss to the Germans in these operations, of course, is the battle-cruiser "Moltke," which, by the way, paid a visit to New York shortly after being commissioned as a return courtesy following the visit to Kiel of the American battleship squadron that made the trip around the world. She is a sister ship to the "Goeben," which now forms a part of the Turkish fleet off Constantinople. The "Moltke" was 610 feet long and displaced 22,640 tons. Her maximum speed was 28½ knots. She carried ten 50-caliber 11-inch guns, twelve 5.9-inch and twelve 3.4-inch rapid-fire guns. She was equipped with 20-inch torpedo tubes. This ship formed one of the battle-cruiser fleet which ran up against the British cruiser fleet in the North Sea and made a running fight of it while fleeing for its home port. The loss of the "Moltke," which, by the way, is denied by the German government, is said to have been due to a British submarine. This is possible, for the German authorities have stated that there are six British submarines operating in the Baltic. The details regarding these operations are meager, the Russians emphatically asserting that the losses given above occurred, the Germans denying it, and the British accepting the Russian account, but with some reserve.

The Farmer and Inventions

IN demonstrating the beneficial influence of inventions upon agriculture, a Senate document of years ago suggested taking "the inventions to which there has been more opposition by the farmers than all others, viz., the 'drive well' and the 'barbed wire' patents." Although the drive-well patent, after nine suits at the Circuit and four in the Supreme Court, was declared void two years after it had expired, the invention was nevertheless of great value to our farmers and stock raisers. It reduced the cost of a well from $50 or $60 to $20 or $25, and as there are at least three quarters of a million of those wells in the country, the saving to the farmers has been from $22,000,000 to $25,000,000 by that one invention in cost alone, to say nothing of its benefits otherwise.

According to the leading agricultural paper of Iowa, the cost of fencing in the west was reduced one half, or 50 cents per rod, by the use of the barbed wire. Up to 1899 there had been 1,746,153,600 rods of wire fencing used, the saving to the farmers and stock growers being $873,076,600. And yet that very State of Iowa appropriated money to support an opposition factory and fight the patents, but after years of litigation they were sustained by the Supreme Court. It is important to note that no farmer or user was ever sued by the owners of the patents, only infringing manufacturers.

Prizes Offered by Papermakers

THE Technical Section of the American Paper and Pulp Association is offering four prizes of $100 each for the best papers on the following practical problems met with in paper making.

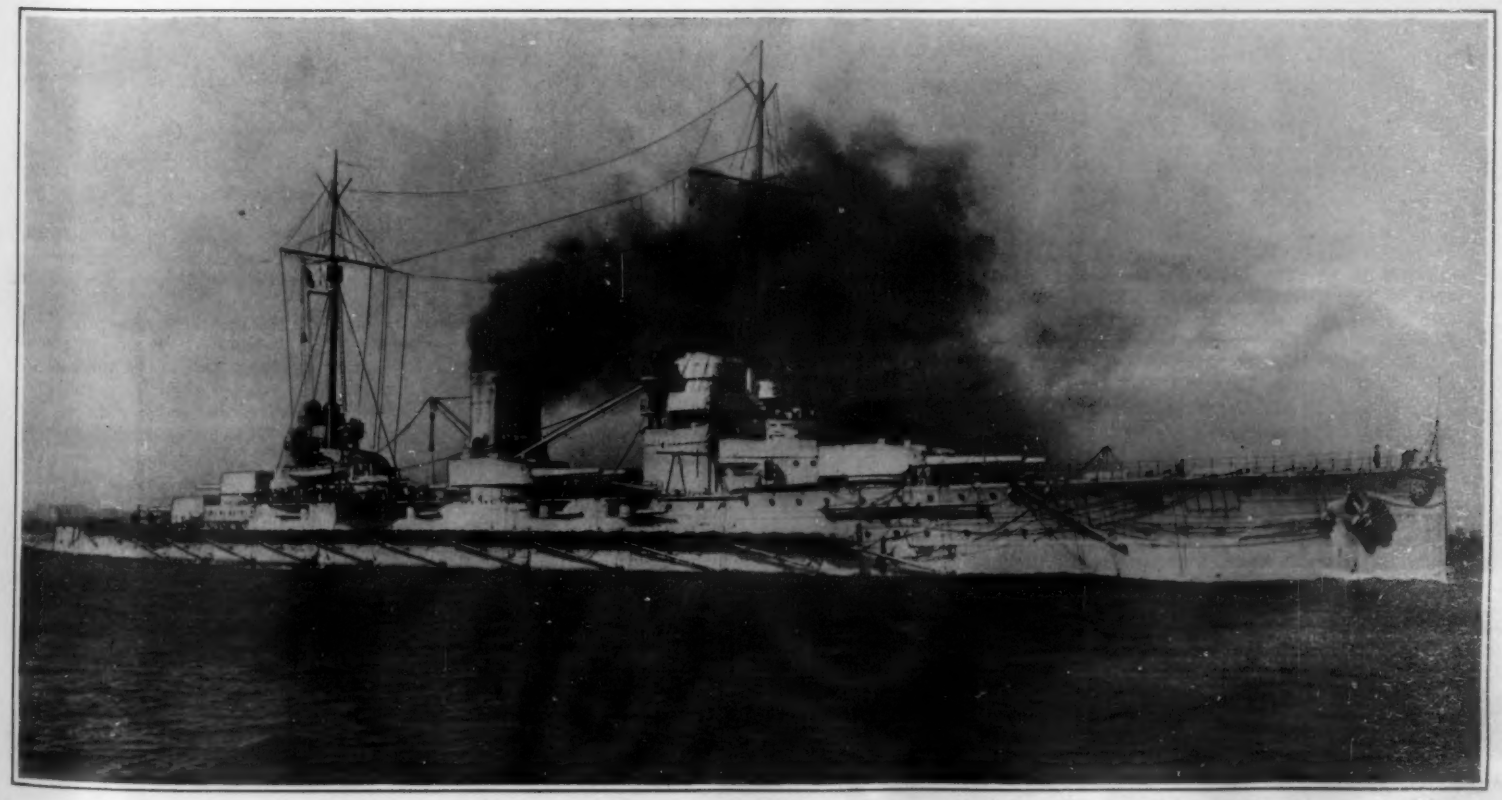
1. The various causes for the deterioration of the Fourdrinier wires and steps to be taken in the prolongation of the life of the wires.

2. How can the pitch in sulphite pulp be eliminated?

3. The effect of the order and time of adding alum, rosin and color on the retention of color.

4. The retention of the various mineral fillers used in paper making and their effect on the life of the machine clothing and the quality of the paper.

The papers must be handed in before December 31st, 1916, in accordance with various prescribed conditions. The address of the association is 18 East Forty-first Street, New York, where additional information can be had.



Displacement, 22,640 tons. **Speed,** 28.5 knots. **Armor,** 11 inches. **Guns:** Ten 50-caliber 11 inch; twelve 5.9 inch; twelve 3.4 inch. **Torpedo tubes,** 4.

German battle-cruiser "Moltke," reported lost in the recent Baltic Sea fight.

The Loss of Two Great Physicians

Dr. Paul Ehrlich

VIRCHOW established the fact that all life—human, animal, vegetable, bacterial, parasitic—is cellular; life exists by cell reduplication; *omni cellula e cellula*—every cell from a cell. On this fact Prof. Ehrlich, who died August 20th last, in his sixty-first year, based his side chain theory.

Ehrlich believed that every type of living cell has a special affinity, a peculiar and individual attraction, for some particular substance. It has long been known to physicians, at least since Paracelsus, that certain drugs have a selective action: such drugs, when taken into the body, are not equally distributed throughout its tissues, but if administered as "indicated" for the ailment suffered, go "right to the spot."

The side chain theory is indeed a brilliant chemical conception, which explains in the most satisfactory way we know some hitherto inexplicable phenomena of immunity to disease. This theory, like that of Ehrlich's brother-in-law, Weigert, regarding the nature of inflammation, takes into account Nature's prodigal preparations for the repair of bodily injuries. For instance, a much larger amount of antitoxin is produced than is necessary to neutralize any given toxin. The fundamental processes of immunity, Ehrlich held, reside in the body cells. These cells being attacked by a given poison, and if not thus destroyed, are stimulated to an overproduction of "antitoxins" capable of combining with and neutralizing the poisons (toxins) evolved by the offending bacteria. The hungry protoplasm of any cell, with its complicated molecule, having side chains of various combining affinities, ready to unite with suitable food molecules brought to it by the blood and body juices, lies at the bottom of Ehrlich's explanation of the chemical production of the antitoxin. Indeed, by his theory, the same combining affinity exists between the cell protoplasm and the proteid molecules that furnish its food, as between the cell protoplasm and the bacterial toxins or poisons.

While Ehrlich, who was peculiarly endowed with the "chemical imagination," was seeking to determine the effect of dyestuffs alone and in combination on the different tissues of the body, the discovery was announced that the parasite called the *spirochaete pallida* is the essential cause of syphilis. On this disease, then, Ehrlich experimented, recording six hundred and five failures after extraordinary perseverance and concentration. The six hundred and sixth combination, dioxydiamido-arseno-benzol, proved a cure of the Great Black Plague. And this "salvarsan," with quinine against malaria, is one of the only half a dozen truly specific medicaments which have been demonstrated in the history of medicine since Hippocrates. Thus did Ehrlich establish chemotherapy—healing by chemical means—an achievement which, with his work in the treatment of diphtheria, cancer and the sleeping sickness, entitles him to stand with Bernard, Pasteur, Koch and Lister—among the very first physicians, indeed, of whom the world has ever had knowledge.

Dr. Charles J. Finlay

On the same day, August 20th, last, when Dr. Paul Ehrlich died in Homburg, another very great physician, Dr. Charles J. Finlay, died also, in Havana. In 1881, Dr. Finlay announced his theory that yellow fever is transmitted from sufferers of that disease to the well by a mosquito's bite, and in no other way. As has been the case with so many a genius before him, his ideas were either ignored or ridiculed, in and out of medical science. Yet he lived to see his theory demonstrated by the United States Army Board—nearly a score of years, however, after its enunciation. Dr. Finlay himself submitted to inoculation; but his demonstration failed because he used mosquitoes that had bitten yellow fever patients within but five days; whereas it was later shown that the mosquito is harmless until twelve days or longer after the biting.

When our Army occupied Cuba in 1898, Yellow Jack had been epidemic, indeed, practically endemic (that is, constant) in Havana, and despite all the then known methods of fighting that infection, there were 1,500 cases and 231 deaths among American officers and men in the year 1900. Dr. George M. Sternburg, Surgeon-General of the United States Army, appointed a board of four surgeons then on duty in Cuba, Walter Reed, James Carroll, Jesse W. Lazear and Aristides Agramonte, to test Finlay's theory of mosquito transmission. The world knows of the heroism of these men and of many other volunteers, by whom it was established that: The mosquito known as *Stegomyia*, and only that insect, serves as the intermediate host for the parasite of yellow fever; this disease is transmitted to the non-immune by means of the bite of *Stegomyia* that has previously fed on the blood of one sick of this disease; an interval of twelve days or more after contamination is necessary before *Stegomyia* can convey the infection; the period of incubation (from the bite to the appearance of symptoms) in yellow fever varies from forty-one hours to six days; yellow fever is not conveyed by fomites, wherefore disinfection of articles of clothing, bedding or merchandise, supposedly contaminated by contact with the yellow fever sick, is unnecessary. In the mind, then, of the physician just passed away in his eighty-second year, was conceived the theory by the establishment of which, one of the age-long terrors of the tropics has forever been vanquished. Nor could the Panama Canal ever have been built (how disastrous was the French attempt!) had not devoted and zealous men, from Finlay to Gorgas, so magnificently and with so much altruism, suffering and martyrdom led up to and applied the discoveries and the resources of medical science to the colossal enterprise.

Mathematical Coincidences

By Alfred J. Lotka

IT is well known that the ratio of the circumference of a circle to its diameter is an incommensurable number, that is to say, a number which can not be exactly expressed as a decimal fraction having a finite number of figures.

But it is perhaps not so well known that some rather close approximations of π can be expressed in simple form.

Thus, for example, π is very nearly equal to $\frac{355}{113}$ which in decimal form is 3.14159292

π =	3.14159265
Error	0.00000027

How remarkable this coincidence is may be shown by comparing the case of π with that of another incommensurable number, the basis e of natural logarithms. The nearest approach to this expressed as a common fraction using only three figures in numerator and denominator is $\frac{310}{114} = 2.7193$

e =	2.7183
Error	0.0010

It will be seen that the error here is 4,000 times greater than in the case of π.

Another remarkable approximation in simple numbers is the ratio $\frac{\sqrt{4-\pi}}{\sqrt{\pi}}$ which is very nearly equal to $\frac{23}{44}$ as shown below:

	$\frac{\sqrt{4-\pi}}{\sqrt{\pi}}$	$\frac{23}{44}$
	0.5227232	0.5227272
Error		0.0000040

Another remarkable relation, though the degree of approximation here is only imperfect, is that π is about equal to $\sqrt{3} + \sqrt{2}$, viz.,

$\sqrt{3}$ =	1.7321
$\sqrt{2}$ =	1.4142
	3.1463
π	3,1416
Error	0.0047

Curiously enough, the basis e of natural logarithms is approximately equal to $\sqrt[3]{3} + \sqrt[3]{2}$

$\sqrt[3]{3}$ =	1.4422
$\sqrt[3]{2}$ =	1.2599
	2.7021
e =	2.7183
Error	0.0162

Variation in Bacteria

"THE bearing of slight physiological differences upon the classification of bacteria and upon the phenomena of infection has made the occurrence of variation among bacteria fully as conspicuous as in the higher forms of life." These words form the introduction to a paper on "Variation in Bacteria," which Edwin O. Jordan of the department of hygiene and bacteriology of the University of Chicago has contributed to the March, 1915, issue of the *Proceedings* of the National Academy of Sciences.

The difficulty of distinguishing true variations from environmental modifications and from the development of latent characteristics is then explained. Latent characteristics are properties which are usually dormant but are awakened by definite external influences. For example, some bacteria form spores in the presence, but not in the absence, of oxygen. This is merely a response to changed conditions, like the transformation of a certain species of shrimp to an apparently different species by transferring it to saltier water. Many alleged instances of variability in bacteria are of this character, and this justifies the standardization of culture media.

Environmental modifications are fundamentally similar to these expressions of latent characteristics, for both are due to an innate capability of response to a definite influence. Environmental influences, however, tend to produce similar results in different organisms. Although environmetal modification and selective adaptation are totally distinct, they are often difficult to distinguish, especially in bacteria, which pass through many generations in a short time.

Most of the observed variations of bacteria are apparently adaptive, whether due to direct action of the environment upon thousands of individuals or to the advantage possessed by those cells that have acquired a new peculiarity, such as that of fermenting a particular carbohydrate. Many alleged instances of mutation might equally well be regarded as due to the selection acting upon the so-called fluctuating variations. The newly acquired property may, or may not, be permanent for many generations on other media.

For the past three years the author has cultivated under varying conditions two pure line strains of bacteria, the parents of which were two cells taken at random from among hundreds of millions of descendants of a single cell of *Bacillus coli*. The most fundamental change observed is the acquisition of saccharose-fermenting powers by one of the strains. In the seventh transfer of a culture on sodium chloride agar this quality appeared in most of the cells, and the cells of the other type disappeared altogether on continuing the transfers.

The saccharose-fermenting strains fermented raffinose also. This new fermenting property has remained permanent through more than five hundred generations, even in cultures transferred immediately to ordinary agar.

"This instance of bacterial mutation, therefore, seems to fulfil the requirements (*a*) of appearing suddenly without intermediate stages, (*b*) of being irreversible, at least for three years and for some hundreds of test-tube generations, (*c*) of comprising changes in two characters (saccharose and raffinose fermenting power), and (*d*) of not involving all the cells of the parent strain."

It is noteworthy that most classifications of *B. coli* groups have been based on the power to ferment saccharose, and that this power has been acquired by a strain not originally possessing it, only once in the course of these experiments, and then on sodium chloride, while cultures of the parent organism in saccharose broth have not acquired it.

"This particular change, therefore, seems to be due to the intra-cellular or molecular changes brought about by non-specific influences, and not to a direct adaptation to particular environmental conditions."

Superposed Stereoscopic Pictures That Need No Stereoscope

IN the usual process of stereoscopy the object or scene is photographed with a double camera, having two objectives separated by the interocular distance of about 2.8 inches. Positive prints of the two slightly different negatives thus obtained are transposed and viewed through the two lenses of the stereoscope, which are separated by the same distance.

In each of two novel methods referred to in a recent number of *Prometheus* (No. 1,325), both positive images are impressed on a single plate or film, not side by side, but with their centers coinciding, and the resultant composite picture produces the desired stereoscopic effect when viewed with the naked eye.

In the process invented by W. R. Hess of Zurich, the negatives are made in the usual way, and the positive copies are produced in a layer of collodion on the back of a transparent celluloid film about one sixteenth inch thick. The front of the celluloid film is ruled with parallel lines, ninety to the inch, and the impressions are made by light coming obliquely from the right for one picture, and from the left for the other picture. The result is that both pictures are divided into narrow parallel strips which alternate on the film. When the composite picture is held in the correct position and viewed from the ruled side of the film, the ruled lines hide the strips of one partial picture from the right eye, and those of the other partial picture from the left eye, so that the stereoscopic effect of relief is produced. The picture may be used as a transparency, or it may be mounted on a white background and viewed by reflected light. The focal length of the camera, the thickness of the celluloid film and the number of lines to the inch are connected by definite numerical relations with the distance from which the picture should be viewed.

In the method invented by Reiffenstein and Friedmann of Vienna, the superposed stereoscopic pictures are positive, having the pale gray tone of a ferrotype, like which they are mounted on a black background, so that they can be viewed only by reflected light. The pictures are formed in a layer of collodion, which is ruled with one hundred and fifty lines to the inch and is carried by a glass plate, the back of which is similarly ruled. The proper point of view, which depends on the width of the strips in which the pictures are divided, the number of ruled lines to the inch and the thickness of the glass, is not found so easily as in the Hess method.

RECENTLY PATENTED INVENTIONS

These columns are open to all patentees. The notices are inserted by special arrangement with the inventors. Terms on application to the Advertising Department of the SCIENTIFIC AMERICAN.

Pertaining to Apparel.

EMBROIDERED FABRIC.—J. SCHWARB, care of North Hudson Embroidery Works, Union Hill, N. J. The fabric is such as is used for flounces and the like on women's dresses and other garments, the embroidered fabric being provided with an embroidered border arranged to allow the lower portion of the fabric to overlie a portion of the border without being attached thereto, with a view to produce a very fine effect.

HANDKERCHIEF.—MILDRED K. POTTER, 239 Main Ave., Passaic, N. J. The purpose here is to provide a handkerchief which, besides its customary use as such, provides a means to enable the user to apply powder to the face, especially in public places, and without embarrassment or attention or the necessity of privacy.

PROTECTIVE APRON.—H. P. RINDSKOPF, 397 Sumner Ave., Brooklyn, N. Y., N. Y. This invention provides means for protecting women's outer garments from damage during certain periods of illness; allows a garment of the character named to yield, and so avoid wearing strains or stresses; and minimizes the weight of the garment.

UNION SUIT.—D. C. COLLIER, Barnesville, Ga. The invention is an improved union suit or garment adapted for use by both women and men. The object of the invention is to provide a garment of this type which may be advantageously made out of tubular fabric, preferably knitted fabric composed of cotton, silk, ramie or wool.

HAT.—H. GREENBERG. Address Greenberg & Lave, 145 Greene St., New York, N. Y. The object of this invention is to provide a new and improved hat more especially designed for the use of women and arranged to closely resemble in flexibility, firmness and durability the soft, flexible and very expensive hats formed of Milan straw braid.

Pertaining to Aviation.

ENGINE.—J. D. BARTER, Mirror Lake, B. C., Canada. The invention relates to that class of engines in which a multiplicity of cylinders are connected to a single crank casing and adapted to rotate around a center of such casing. The engine is compact and adapted especially for aeronautical operations, the number of parts being comparatively small, and the weight being small in comparison with its power.

AUTOMATIC SELF STABILIZING PLANE FOR AEROPLANES.—R. S. HARTZ, Vancouver Barracks, Vancouver, Wash. An object here is to provide an automatic self stabilizing plane or planes to be used in aeroplane construction. Another object is to dispense with numerous pieces of mechanism heretofore necessary in the stabilizing of aeroplanes and rendering the aeroplane self balancing and self righting.

Electrical Devices.

ILLUMINATED MATCH STAND AND AUTOMATIC ELECTRIC WAITER SIGNAL.—A. MARTZOLF, 162 E. 46th St., New York, N. Y. The invention relates to improvements in match stands and signal devices, and has for an object to provide an improved construction for use on dining tables and at other points for signaling without noise and without disturbing anyone in the immediate vicinity.

IGNITION MAGNETO DRIVING COUPLING.—J. W. MONTAGUE, 403 Union Bank Bld'g., Winnipeg, Manitoba, Canada. This invention relates to ignition magnetos of that type whereby the shifting of the spark is effected by adjusting the relative position of the magneto armature with respect to the driving shaft through a coupling that comprises a slidable sleeve feathered to the respective shafts by worm or helical grooves, whereby the sliding of the sleeve produces relative rotation of the shafts for the purpose of retarding or advancing the spark.

Of Interest to Farmers.

COLTER.—S. H. PHELPS, care of Blount Iron Works, Evansville, Ind. This inventor provides a support for a revolving colter blade adapted for attachment to a plow beam so that the blade may be adjusted at the proper angle so as to be set vertically or at an angle with respect to the ground, or adjusted up and down according to the depth of the furrow to be cut.

MAILING CASE FOR EGGS.—O. W. WARD, Room 52, 96 Fifth Ave., New York, N. Y. The invention relates to shipping and storing vessels, and has particular reference to the shipment of commodities by parcel post, express or the like. It provides a package or container of such a nature as to make the shipment of fresh eggs through the mails a practical expedient.

HAY SHOCKER.—H. E. GREGORY and C. A. GREGORY. Address McGlasham & Gow, Suite 8-9 Colorado Bld'g., Trinidad, Colo. This hay shocking apparatus is associated with a hay rake, and following the latter so that as the hay is raked and dumped in a windrow, the shocking apparatus will pick up the dumped hay and deposit the same in a receptacle. When sufficient hay has been accumulated in the receptacle to form a shock, the shock is dumped by dropping the bottom.

PLOW.—B O. CUMMINGS and D. S. MCARTHUR. Address the former, care of The Baird-Adams Co., Portland, Ark. One of the principal objects of this invention is the provision of a mechanism for adjustably connecting together a pair of light turning plows whereby the work ordinarily done by two men may, in the same length of time, be accomplished by one man.

GRAIN SPOUT ADJUSTER.—B. DE BOER. Address George E. Culver, Corsica, S. D. The invention relates to improvements in adjusting means for grain chutes or spouts, and has for an object to provide an improved construction adapted to be used in any place, especially on a thresher whereby the discharging chute may be moved to any desired position and locked in said position.

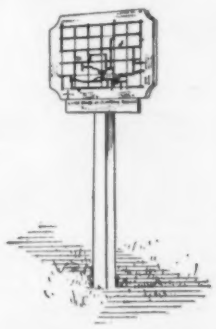
MULSHER.—J. C. SIKES. Address J. J. Darnell, Greenville, Tex. This device is designed for cultivating growing crops with plants in rows, such as corn, cotton and the like, wherein a blade is provided for cutting the weeds and the like below the surface of the ground, and arranged to throw the soil toward the row, thus hilling the plants, as well as destroying the weeds, and wherein means are provided in connection with the blade and co-operating therewith, for preparing and leaving a blanket or mulsh of fine soil on the surface, thus preventing the escape of the moisture from the ground.

BOX PRESS.—B. C. SKINNER, Dunedin, Fla. The object here is to provide a box press having clamps so constructed and operated that they will not interfere with the handling of the crate and its proper positioning on its support, the clamps having such movements that when disengaged from the crate they are in a position whereby they will not interfere with the positioning of the crate.

CREAM SEPARATOR.—O. M. PAGE, Worthington, Ind. This invention relates to mechanical separators, and more particularly to cream separators, the object being to provide certain improvements therein, including a single member forming separate cream and skim milk outlets, such as will promote simplicity and economy and, at the same time, increase its efficiency in the operations for which it is intended.

Of General Interest.

GUIDE-BOARD.—W. A. FUSCH, Room 8, Stine Bld'g., Decatur, Ill. This invention is a guide-board bearing a diagrammatic illustration of a district with township sections and roads indicated by differentiated lines, and having a movable device adapted to be set in the guide-board at any desired point which serves



GUIDE BOARD.

to indicate the location of said guide-board in the particular district or township delineated by the map on its face. The guide-board has a border on which is inscribed names of towns and other locations lying outside the one in which the guide-board itself is located, and also the distances of such towns and locations from points indicated on the map proper.

DEVICE FOR TREATING ORES.—J. A. FLEMING, Globe, Ariz. The object here is to provide a device in which the ores are treated to the leaching action and the lixiviate containing the valuable metal is then separated from the remaining portions of the ore by a filter or screen, and in which there is no possibility of the filter becoming clogged up, since it is constructed to be self-cleaning.

COMBINED BILL BOOK, CHECK BOOK, AND PASS BOOK.—B. C. HART, care of Pioneer Trust and Savings Bank, Basin, Wyo. One of the principal objects of the invention is to provide a combined bill, check and pass book having a pocket provided in one leaf of the cover, in the form of a frame for the reception of a deposit sheet to be inserted and used by the bank, in listing deposits made in the bank during the month.

ASEPTIC INSTRUMENT CASE.—H. PEDRETTI. Address Becton, Dickinson & Co., Rutherford, N. J. The case is arranged to hold the liquid sealed whenever the instrument is withdrawn from the case, thus preventing the loss of the liquid by leakage, evaporation or other causes, and to allow the liquid to surround the instrument on inserting the latter into the case, thus holding the instrument immersed in the liquid while the instrument is not in use.

SELF CLEANING LIQUID FILTER.—T. LINKE, 235 W. 46th St., New York, N. Y. One of the objects of the invention is to provide novel means for the removable attachment of a pair of scraping blades forming a self-cleaning means for the filtering medium or porous stone whereby the impurities which lodge on the surface thereof may be conveniently removed to prevent retardation to the filtering of the water therethrough.

DEVICE FOR ASSEMBLING THE PARTS OF PASTEBOARD BOXES AND OTHER SIMILAR PACKINGS.—L. PLANCHE, 130 Rue du Faubourg Saint-Denis, Paris, France. The invention refers to a device for assembling the parts of boxes made of pasteboard and other pasteboard packings, as well as those made of strong paper and other similar materials, allowing of uniting quickly and safely all the component parts of the body or of the lid of such packings or of their fastening flaps and the like.

HEADACHE PAD.—F. H. LEITHEISER, 124 E. Ave., Long Island City, N. Y., N. Y. The invention comprehends a pad of new and useful construction especially adapted to receive a quantity of suitable medication, the pad being adapted to be applied to the head and extending around the temples, whereby headaches may be treated externally.

BEVERAGE PRODUCING MATERIAL AND PROCESS OF MAKING SAME.—H. BARNHARD, Nooksack, Wash. The ground material is subjected to the action of boiling water and the resultant concoction is preferably strained to separate the grounds from the beverage. By using more or less of the beverage-producing material in a given quantity of water any desired strength may be given to the beverage to suit the taste of the user.

STAR FINDER.—O. F. BARCUS, 20 Kroenming Road, Shanghai, China. This inventor provides a star finder in the shape of a parasol on which fixed stars and the constellations are marked as a guide to be used in finding their location in the heavens. The stars are positioned relatively to the stick of the parasol, so that when the outer end of the stick is pointed to Polaris the stars on the parasol will be positioned for convenient observation.

ADJUSTABLE AND FOLDABLE SAWHORSE.—E. F. VARACHE, JR., Liberty, New Mex. The invention has to deal more particularly with a sawhorse having adjustable and foldable legs, whereby the range of usefulness of the device is greatly increased. It provides a sawhorse having longitudinally extensible legs whereby the sawhorse can be used on sloping surfaces and staircases as well as on the level.

PRINTING PRESS TYMPAN BAIL.—S. L. HOWARD, 1221 Wabash Ave., Chicago, Ill. The invention provides a printing press with means for preserving tympan sheets and the make-ready secured thereon when the same is removed from service on the press; and provides a simple, efficient construction for maintaining the original registration of the make-ready.

FLUSH SIPHON.—M. H. GREESON, 217 Lafayette St., Tampa, Fla. One object, among others, in this case is to provide a rigid non-movable siphon whereby to eliminate the usual siphon seat and rubber gasket utilized in the ordinary lift siphon now in use to promote a non-leaking structure resulting in the prolongation of the life of the usual ball cock washers and the elimination of practically all repairs.

FUSIBLE SAFETY PLUG FOR BOILERS.—A. D. TOWNE. Address J. E. Rieger, Attorney, Kirksville, Mo. This plug insures the escape of steam when the water becomes low, even if the plug should be covered over by scale on the interior of the boiler. The plug has novel means for breaking up the scale so as to permit the heat of the steam to have access to the fusible plug, and to permit the steam to escape freely through the opening caused by the melting of the plug.

EVAPORATOR.—O. SÖDERLUND, Fairlawn, Clarence road, Clapham Park, London, S. W., England. This invention relates to improvements in connection with the evaporation, distillation or concentration of liquids and similar operations. The evaporation is effected in an apparatus without the employment of more than a small amount, if any, of external heat supplied as such to the apparatus.

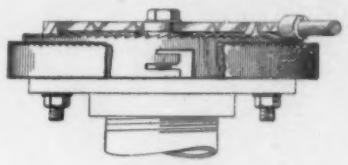
METAL DOOR.—J. E. FREY, 821a Quincy St., Brooklyn, N. Y., N. Y. The improvement provides a metal door with means for holding the members of the door together. One of the members of the door has inwardly disposed flanges and another member of the door has looped portions, tie members being provided for engaging the looped portions and a key being provided for holding the tie members in position relatively to the flanges.

MEMORANDUM BOOK.—B. STEMBER, 353 Fifth Ave., New York, N. Y. This invention provides a book arranged to permit of placing a desired number of loose leaves or a pad in position between the two covers or removing any one or all of the leaves from between the covers to allow convenient turning over of the leaves in order to reach any particular one for reference or for writing additional memoranda thereon.

GRATING.—A. DARROCH, 368 Ninth St., Brooklyn, N. Y., N. Y. This inventor provides a grating for use in the roofs of subways, pavements, buildings and other structures, and arranged to prevent rain water, debris and the like from passing through the grating, to illuminate the space below the grating by refracting light, and to provide proper ventilation for the said space.

Hardware and Tools.

WRENCH.—A. MCLEAN, 1518 Fifth Ave., Anacortes, Wash. This invention is an improvement in wrenches, and has for its object to provide a tool especially adapted for placing or removing threaded flanges on pipes

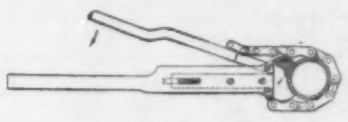


WRENCH.

wherein the wrench is so arranged that it may be rigidly connected to flanges of various sizes, and wherein mechanism is provided in connection with the wrench for turning the wrench and the flange in either direction.

DOOR HASP.—J. D. CESENA, Minden Mines, Mo. The hasp is adapted to be pivotally connected to a door and normally movable into or out of engagement with a staple carried by the door frame for maintaining the door in closed position or for allowing opening of the door respectively, said hasp provided with staple-receiving means whereby the hasp may be engaged over the staple when moved into a third position in order that the hasp may be locked in this position by a pad lock or other suitable device.

DOUBLE ACTING PIPE WRENCH.—R. J. COSSEBOOM. Address Sindlinger & Niles, Box 61, Buena Vista, Colo. This invention relates more particularly to wrenches in which a flexible chain is utilized in gripping the work. It provides a wrench of the type set out having

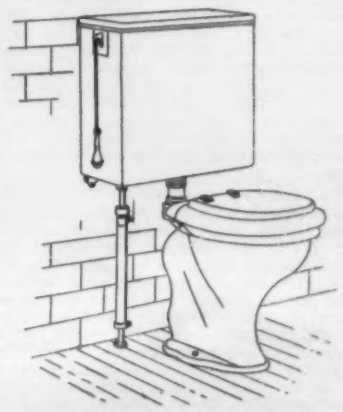


DOUBLE ACTING PIPE WRENCH.

a claw or jaw shiftable longitudinally of the wrench into engagement with the work to erect a binding force thereagainst in a direction opposed to that of the chain, and in such a manner that the wrench may be manipulated in either direction without danger of slipping.

Household Utilities.

ATTACHMENT FOR FLUSHING TANKS.—B. L. CHAMBERS, Box 426, Fruita, Colo. This invention is an improvement in attachments for flushing tanks, and has for its object the provision of a connection between a flushing tank and its supply pipe for absorbing and



ATTACHMENT FOR FLUSHING TANKS.

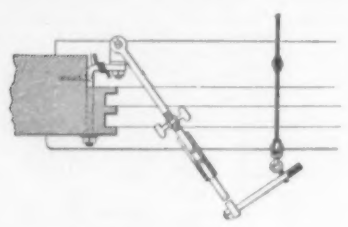
eliminating the chattering, jarring noises incident to the refilling of such tanks after flushing. The accompanying engraving shows a perspective view of the invention with the improved pipe in place.

CLOTHES PROP LINE FASTENER.—H. M. KRAUSER, 638 Lafayette St., Norristown, Pa. The invention relates more particularly to a fastener for securing the upper end of the prop to the clothes line, whereby disengagement of the prop from the line or vice versa with consequent releasing of the line from the notch of the prop and resultant falling of the clothes to come in contact with the ground, will be obviated.

SAD IRON.—J. PURETZ and B. COHEN, 24 E. 8th St., New York, N. Y. The invention provides an inexpensive iron in which the flame is generated by a burner located within the iron, said iron having an undulating surface on which the gas flames are caused to play, so that the maximum surface is exposed to the

flames and, consequently, very little heat generated by the burner is wasted.

SWINGING CLOTHES LINE SUPPORT.—F. M. BORJA, 825 W. 179th St., New York, N. Y. This invention relates particularly to supports which may be connected with a window frame so as to swing interiorly and outwardly, as desired. The invention provides an



SWINGING CLOTHES LINE SUPPORT.

improved swinging clothes line which may be readily moved into the room and moved out of the room at any time, and also readily adjusted for tightening the lines carrying the clothes.

Machines and Mechanical Devices.

TUBING BLEEDER.—G. C. BUSHONG. Address H. H. Bell, Attorney, Maricopa, Cal. This device is adapted for use in well casing, as, for instance, oil wells and the like, for permitting the tubing to be drained of oil, water and the like, without the necessity of pulling the tubing from the well casing, wherein a detachable connection is provided between two adjacent tubing sections, capable of being operated from the top of the well, and wherein a perforate barrel in connected with the lowermost of said sections and slidably connected with the other of said sections to permit sections to be separated from each other while yet connected by the barrel.

CIGAR CUTTER.—P. V. PEREZ, P. O. Box 545, Key West, Fla. This invention is an improvement in cigar cutters, and has for its object the provision of a simple, easily operated device of the character specified, for cutting cigars to the required length, and at the same time registering the number of cigars cut. A locking device is provided for temporarily preventing the operation of the cutter and registering mechanism.

SANITARY WATER FOUNTAIN.—J. J. PIPER, 1621 North Carona St., Colorado Springs, Colo. The object here is to provide a fountain adapted to be connected to any desired valve, and wherein mechanism is provided in connection with the fountain for filtering the water as it passes from the valve to the container.

EXCAVATOR SHIELD.—D. W. MURPHY, 602 Federal Bld'g., Los Angeles, Cal. This invention relates to trenching or excavating machinery, and has particular reference to means for temporarily preventing the caving in of the walls of a trench or excavation, and is used in connection with or drawn or propelled behind any usual or approved type of trenching machine or excavator.

STAPLING MACHINE.—C. J. PFRIEMER, Wales Ave. and 142nd St., Bronx, N. Y., N. Y. This invention provides a means for twisting the prongs of a wire staple which has been applied to a piece of work, snipping off the points or untwisted portions thereof, and then subsequently clenching the portion of the staple thus twisted, whereby an indefinite number of pieces of work may be treated in a uniform manner as to the application of the staples thereto and the appearance of the finished product.

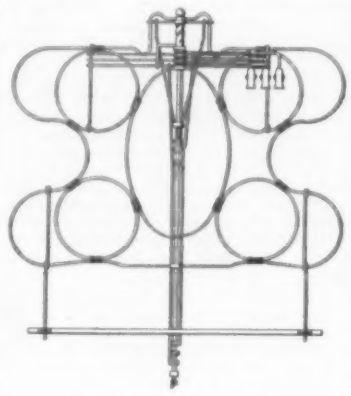
MECHANICAL MOVEMENT.—S. SYLVESTER, Lisbon Falls, Maine. The adhesion of a wheel to whatever it bears on must be greater than the tractive force required to move the load, otherwise the wheel will slip. This invention equalizes the pull and push, so that the power to move the load is the same when the crank-pin is below the axle as it was when the crank-pin was above. The reason that a locomotive wheel slips when the crank-pin is below the axle, more than when above the axle, is because the push back against the wheel requires more adhesive power to prevent it slipping than is required when the crank-pin is above the axle. This condition exists because of the way the power is applied to the adhesion.

QUICK WINDING DEVICE.—J. E. JOHNSON, 22 Boerum Place, Brooklyn, N. Y., N. Y. The invention provides facilities for winding a clock or the like by means of a simple, quick draft upon a cord, wire or similar flexible connection, the opposite end of the connection being secured to a drum, means being provided to cause the drum to wind up the main spring, and another spring being provided to return or rewind the flexible connection automatically without disturbing the ordinary action of the main spring.

PAPER FEED CONTROLLING APPARATUS.—T. J. BEREGH, care of Chas. Francis, 92 William St., New York, N. Y. This invention provides means for automatically avoiding the feed of paper in damaged condition, or in an irregular manner, to printing presses; arrests the operation of a printing press in the event of damage to the paper being fed; and automatically adjusts the paper being fed, to maintain the register thereof with the printing devices.

Musical Devices.

SHEET MUSIC TURNER.—A. B. ANDROS. Address F. Roger Miller, Attorney, South Berwick, Maine. The invention is an improvement in sheet music turners and provides mechanism



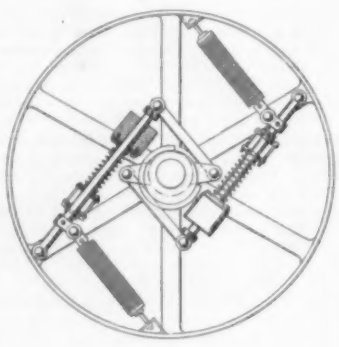
SHEET MUSIC TURNER.

having means for supporting sheet music, and having means for engaging the individual leaves and for turning said leaves in succession from one side to the other, the said means being capable of operation by the musician, and wherein the leaves may be turned from either side.

MUSIC LEAF TURNER.—T. BOLDIZZONI and P. BOSIO, care of the latter, 326 E. 49th St., New York, N. Y. The turner mechanism is operated by a pull wire at the depression of a treadle to cause the engagement of the leaf-turning arm with a music sheet to be turned and then released, or turned to its original position without releasing the leaf, as when repeating or re-reading the matter appearing on a sheet, as well as to adapt the device for books or folios of different thicknesses by permitting the operation of the arm at different angular positions at either side when met with the proper resistance.

Prime Movers and Their Accessories.

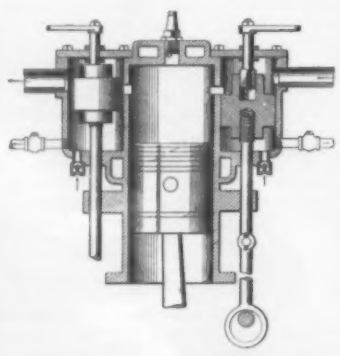
GOVERNOR.—J. D. CUMMINS, Box 404, Station A, Marshalltown, Iowa. The invention relates to shaft governors of the fly wheel type, and the object is to provide a new and improved governor which is exceedingly sensitive, to readily respond to comparatively slight



SHAFT GOVERNOR.

variations in the load and without impairing the stability of the governor. In order to accomplish the desired result, use is made of a spring-pressed governor lever and a spring-pressed weight slidable on the lever.

VALVE MECHANISM FOR INTERNAL COMBUSTION ENGINES.—A. ECKERT, 234 Rector St., Perth Amboy, N. J. This invention



VALVE MECHANISM FOR INTERNAL COMBUSTION ENGINES.

relates to a valve mechanism for motors and more particularly to a valve mechanism for internal combustion engines adapted for controlling the supply or inlet of gases to the combustion chamber which are exploded upon being compressed therein during the reciprocation of the piston or otherwise, as well as the exhaust of the spent gases after the explosion has taken place, as, for instance, in the common four-cycle engine.

GASOLENE CUT-OFF.—J. PAGANO, care of Dr. S. J. Sibley, 414 Randolph Bld'g., Memphis, Tenn. The invention provides a device wherein mechanism is provided for automatically cutting off the liquid fuel at the supply tank from the carbureter, when the engine stops running and wherein other mechanism is provided in connection with the intake of the manifold and operated by the suction generated in the cylinder of the engine by the piston for connecting the supply tank with the carbureter.

INTERNAL COMBUSTION ENGINE.—R. H. OWENS, Station A, Lincoln, Neb. The improvement has to deal more particularly with valve mechanisms of that type in which a tubular valve within the cylinder reciprocates to control the admission of explosive mixture to the cylinder and the exhaust of the spent gases therefrom.

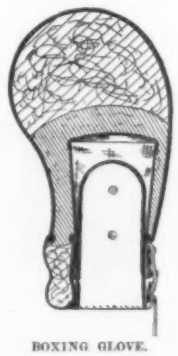
ENGINE AND MEANS FOR CONTROLLING THE OPERATION OF THE SAME.—C. A. KINNEY, Seneca, Pa. An object here is to provide an improved means of starting a gas engine. Further, to provide means for reversing the engine. Further, to provide a device designed to be used for running a well-drilling apparatus having means by which the engine may be permitted to race during the time the drill is dropping.

Railways and Their Accessories.

AUTOMATIC COUPLING FOR TRAIN PIPES.—W. R. SWEET, Wakefield, R. I. This invention refers to coupling devices especially adapted for steam or air pipes of the heating or air-brake system of trains, so that when two cars are automatically coupled by the draft devices, the air, or steam pipes, or both, will be automatically coupled.

Pertaining to Recreation.

BOXING GLOVE.—T. K. TRAVERS, 1445 Atlantic St., San Diego, Cal. In this invention a glove is provided having a resilient socket at one end for receiving the hand of the user, and having a packing at the end of the glove remote from the socket and having a space between the packing and the adjacent end of the socket, the arrangement being such that when a blow is dealt the soft portion of the glove first strikes the object and the socket extends, absorbing the impact of the hand, thus breaking the force of the blow.



BOXING GLOVE.

Pertaining to Vehicles.

TABLE TRUCK.—S. C. DODSON, 2304 E. Fayette St., Baltimore, Md. The present invention relates generally to trucks for transporting articles from one place to another, and more particularly to a truck of considerable length, such as is used as a checking table to receive bolts and rolls of cloth goods and the like by manufacturers and wholesalers.

COMBINATION AUTOMOBILE ENGINE STARTER.—O. P. KNEE, 911 S. 27th St., Lincoln, Neb. The invention has for its object to provide mechanism capable of attachment to existing motor vehicles, and having means for engaging the starting shaft for rotating the said shaft, and capable of being operated from the driver's seat.

CUSHIONING MEANS FOR VEHICLES.—J. A. YOUNG and D. L. YOUNG, 46 Riverside Ave., Santa Cruz, Cal. The invention provides a vehicle spring and attaching means whereby to minimize the possibility of breakage of the spring under rebound of the same; provides a spring and its connections, whereby the spring will be brought into play automatically in proportion to the load or strain exerted thereon; and provides a lifting means for the spring, whereby the leverage between the spring and the frame or chassis may be altered as desired.

WAGON SEAT.—C. F. BLAKESLEE, Rapatee, Ill. The invention relates to a wagon seat of the type mounted on the seat springs, and more particularly involves a means for so suspending the seat on the seat springs that the said springs may respond to the lateral movements of the wagon body without imparting lateral movement to the seat.

ART OF CONSTRUCTING BOWS FOR VEHICLE TOPS.—A. H. STOKES, Library Park Hotel, Detroit, Mich. This invention provides a bow for vehicle tops, in which the same is formed from cold rolled sheet steel in such manner as to provide a bow of the proper cross-section, gradually tapering toward its ends to form the arch and sides as an integral member, as well as the attaching eyes, and providing means for securely fastening the canvas of the top or cover to the top portion or arch of the bow.

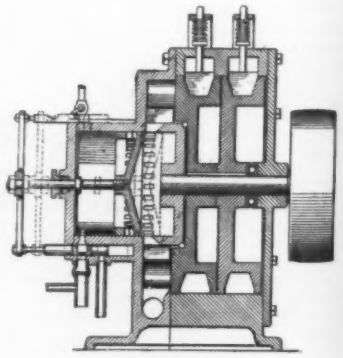
AXLE SPINDLE.—L. FELBER. Address George Untereiner, 202 Carondelet St., New Orleans, La. This invention refers to axle spindles, and more particularly to means for enabling the same to be lubricated without the necessity for attaching or removing the wheel or wheel box, or from disarranging any other part from its normal position.

TIRE RACK FOR AUTOMOBILES.—L. A. NARES, 1001 Griffeito, McKenzie Bld'g., Fresno, Cal. The invention has for its general objects to improve and simplify the construction of automobile racks so as to be reliable and efficient in use, comparatively simple and inexpensive to manufacture, and so designed that the tires can be quickly and easily locked or unlocked.

EMERGENCY BRAKE FOR VEHICLES.—D. E. SCHIMMEL, 165 Rodney St., Brooklyn, N. Y., N. Y. The invention relates to emergency brakes especially adapted for automobiles, although it may be used in connection with other vehicles, and it embodies brake elements which are adapted to be interposed between the vehicle wheels and the road surface, whereby the wheels are removed from contact with the road surface and the brake elements frictionally engage the latter to effect a sudden stoppage of the vehicle.

PROCESS OF MAKING LEATHER TIRES.—E. SPIEGEL, No. 1395, Warnsdorf, Bohemia, Austria-Hungary. The present process makes it possible, owing to the combination with energetic preliminary drying, to obtain, even without the use of mechanical compression, leather tires which remain permanently firm and in a state of tension, even in the driest atmosphere.

ENGINE.—E. F. HOWE, El Centro, Cal. This patent is for a gas turbine with direct connected rotary air compressors and is designed to burn crude oil or other liquid fuel under high compression. By applying the Diesel principle of combustion to a rotary engine, the inventor has sought lightness of construction and



ENGINE.

avoidance of the extreme perfection of mechanism required by the Diesel engine, thus adapting it to automobile use. This engine is intended especially for use in connection with the inventor's previous patent looking to the use of compressed air for transmission in motor vehicles.

Designs.

DESIGN FOR A SUSPENDER WAIST.—LAURA S. COONEY, 657 St. Marks Ave., Brooklyn, N. Y., N. Y. In this case the drawing represents a perspective view of a neat, substantial and attractive suspender waist.

DESIGN FOR A FOUR OUT BOTTLE STOPPER.—W. I. FERRIS, care of L. E. Waterman Co., 173 Broadway, New York, N. Y. In this design the stopper is shown in three views, a perspective, a side and a rear elevation.

NOTE.—Copies of any of these patents will be furnished by the SCIENTIFIC AMERICAN for ten cents each. Please state the name of the patentee, title of the invention, and date of this paper.

WE wish to call attention to the fact that we are in a position to render competent services in every branch of patent or trade-mark work. Our staff is composed of mechanical, electrical and chemical experts, thoroughly trained to prepare and prosecute all patent applications, irrespective of the complex nature of the subject matter involved, or of the specialized, technical, or scientific knowledge required therefor.

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625 F Street, N. W.,
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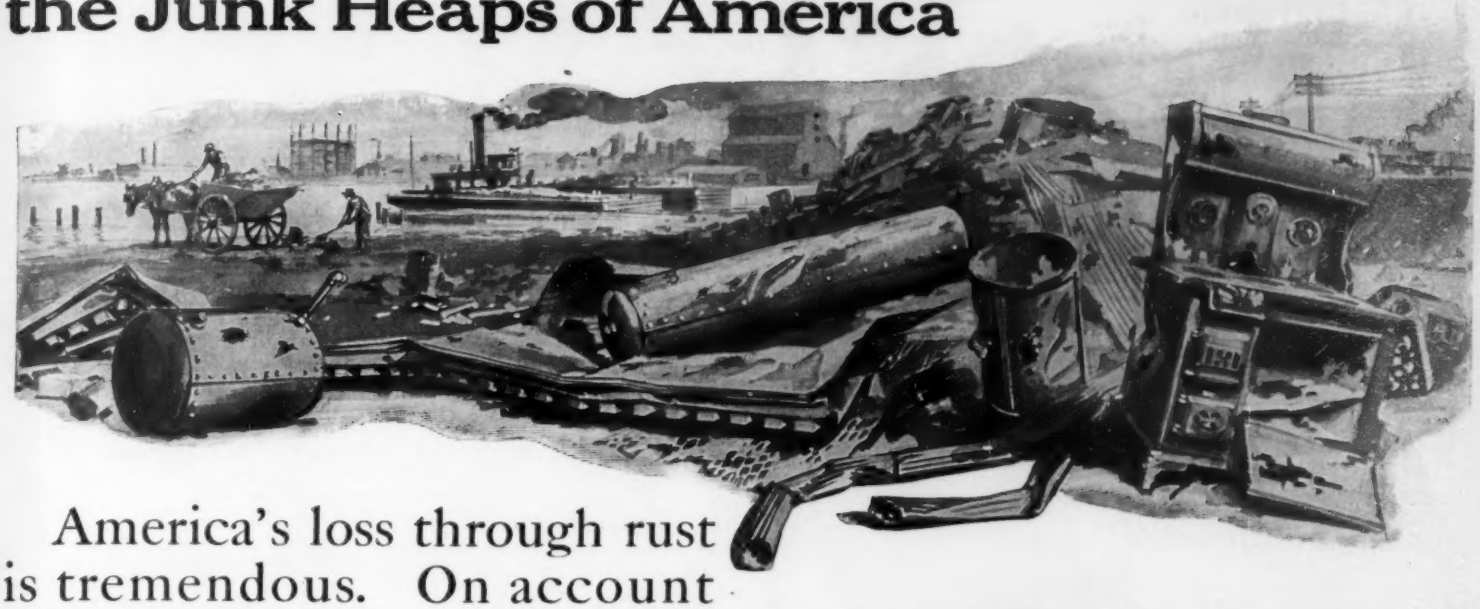
RUST—Not Wear—Builds Up the Junk Heaps of America



America's loss through rust is tremendous. On account of using ordinary, fast-rusting sheet metal, Americans annually lose enough money to build three great super-dreadnaughts.

Look at rust as you would at a tax you believe unnecessary. For most rust is needless. Think what this means. In many instances the ordinary sheet metal lasts but three or four years on a roof. Armco, American Ingot, Iron lasts several times as long.

ARMCO IRON Resists Rust

Armco's great rust-resistance is due to its purity and to its careful manufacture. It is not only the purest iron made but the most nearly perfect in physical evenness, in the elimination of gases and in respect to all the other qualities that form the basis of rust-resistance.

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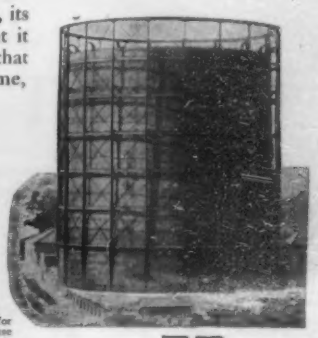

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Armco Iron is specified for cornices, window frames and sashes, ventilator ducts and all other sheet metal work on many of our biggest, finest buildings.

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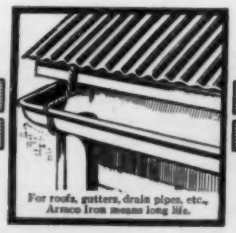

For roofs, gutters, drain pipes, etc., Armco Iron means long life.

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Branch Offices in

Chicago Pittsburgh Detroit New York St. Louis Cleveland Cincinnati

AMERICAN ARMCO INGOT IRON

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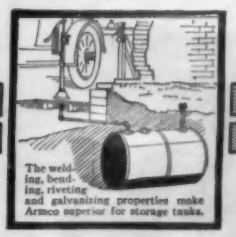
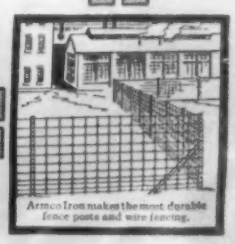


The welding, bending, riveting and galvanizing properties make Armco superior for storage tanks.



Armco Iron makes the most durable fence posts and wire fencing.

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The walls and roof of this building went up without forms, with the very minimum of temporary work.

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Paris Diesel-Electric Station, Paris, Texas. Photo taken February 2, 1915.
Six days later. Ready for the concrete. No forms here.
Finishing up, Feb. 16, '15. Phenix Construction Co. 71 Broadway, New York, Builders
Ready for operation. Photo taken March 30, 1915.

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"The World's Greatest Toolmakers"

NEW YORK LONDON CHICAGO

The L. S. Starrett Company

Emergency Exit from Boiler Rooms

(Concluded from page 201.)

which has been broken away to show the interior of the compartment filled with escaping steam and gases. To the left of the picture is seen the bottom of the emergency trunk with the ladder leading up to the gun deck. In the floor of the boiler room and the emergency exit is built a tank, which is filled with water, approximately to the level of the floor. The bulkhead between the fireroom and the escape front is brought down several inches below the surface of the water in the tank, thereby providing an effective water seal to prevent the passage of steam.

In the event of an accident followed by a rush of steam into the boiler room, the firemen run to the tank (there is one on each side of each boiler room) jump into the water, pass under the lower edge of the bulkhead, climb out by the ladder on the farther side of the tank and so escape to the decks above.

The urgent necessity for an effective device of this kind is shown in the accident to the scout-cruiser "Salem," which occurred while she was backing at full speed in coming to an anchor last fall at Progresso, Mexico. The steam and water was hauled out of number 1 boiler so rapidly that the inexperienced crew failed to prevent low water; and as the result four or five tubes were pulled out of the tube sheet of the steam drum. The ash pan doors gave way and the fire, ashes and steam blew out, filling the fireroom with steam and gases. Some of the men, in trying to escape up through the fireroom, sprung the cover of the escape hatch in the roof of the fireroom, relieving the air pressure and causing a greater rush of steam into the fireroom. Before the men could get over to the uninjured side of the vessel and pass into the coal bunkers, two men were fatally burned. Also one man in a bunker abreast of No. 1 boiler was scalded to death in the forward end of the bunker, where he was shoveling coal, and this in spite of the fact that the bunker was closed and there was no draft, due to chimney effect. The open bunker door was of the same size and at the same level as the door to the escape trunk as now fitted on the "New York" and "Texas." Hence, it is certain that the steam would rush through the open door of these escapes and the long trunk, acting as a chimney, would tend to draw the steam up on the escaping men and bring about a considerable loss of life.

The use of a water seal in a tank such as we have described would render the escape perfectly safe, and we recommend this very practical invention to the attention of the new Advisory Board of Inventions recently formed in the Navy Department.

The Heavens in September

(Concluded from page 202.)

conveniently observable in the evening just to the south and west of Theta Capricorni, as described last month.

Neptune is in Cancer, observable in the early morning.

The Moon is in her last quarter at 10 A. M. on the 1st, new at 6 A. M. on the 9th, in her first quarter at 2 A. M. on the 16th, full at 5 A. M. on the 23rd, and in her last quarter again at 5 A. M. on October 1st. She is nearest us on the 14th and remotest on the 1st and 29th.

While on her round of the zodiac she passes by Mars and Saturn on the 4th, Neptune on the 5th, Venus on the 9th, Mercury on the 11th, Uranus on the 19th, and Jupiter on the 22nd.

At 10 P. M. on the 23rd, the Sun crosses the celestial equator in his southward course, and, in almanac phrase "autumn commences."

Southport, Conn.

Tasks of German Inventors in Wartime

THE blockade of Germany, however imperfect, has caused a scarcity of some of the necessities of industrial occupations and has threatened the future diminution of other essential supplies. This condition of affairs has called forth much discussion in the newspapers and periodicals of that country as to the best methods of meeting the unexpected embarrassment of German economic life. The present situation is felt to be a challenge to German skill in mechanics and chemistry, and scientific men are urged, as a proof of their devotion to the Fatherland, to seek the solution of the industrial problems caused by shortage. An interesting outline of what is needed and what might be done to counterbalance the loss of imports of raw products has appeared in a recent issue of the German journal *Prometheus*. The writer of the article, an engineer named Schulz-Mehrin, can hardly expect that the solutions of all the problems he presents will be found within the period of even a prolonged war, for to vanquish every difficulty that he brings forward would require an entire generation of men of inventive genius. Neither is there much probability in his somewhat naïve conclusion, that by the successful development of artificial substitutes for natural products Germany may be able to control other countries by making the world dependent on it.

The war has proved a stimulus both to industry and invention, but while most inventors are absorbed in the task of meeting the immediate needs of war, such as weapons and comforts for soldiers in the field, there are other demands, also occasioned by war, but lying more within the domain of scientific investigation, which require inventive skill for their settlement.

These latter needs have nearly all arisen through the check given by the war to German imports, and the main difficulty to be overcome is the lack of the raw materials formerly imported from other countries. The textile industry is in need of wool, cotton, jute, flax, and silk. It is true that before hostilities broke out artificial substitutes had been found for some of these natural products, as artificial silk for natural silk, or textilose to replace jute, hemp, etc., in coarse weaves. No substitutes in any way sufficient, however, have been found to take the place of the most necessary raw materials for woven clothing, wool, and cotton. The writer suggests that by some chemico-physical process a thread for weaving may be gained from shavings, straw, or the like, which may meet the requirements, or that the scanty supplies of wool and cotton may be eked out by durable preparations of paper which has already the good quality of being a poor conductor of heat. In the same way the lack of bagging for munitions, fertilizers, sugar, etc., arising from the scarcity of jute, calls for the invention of other suitable holders, such as those already brought forward, as paper bags strengthened by woven insets, combined chip and pasteboard baskets, wooden casks, or for the production of some better form of container.

Some artificial substitute might also be found to replace the decreasing supply of leather, especially for those numerous cases where appearance is more essential than durability, as the genuine leather should now be kept for those articles in which it is absolutely necessary, as boots and shoes.

Among metals there is an especially small supply of copper, tin, aluminium, nickel, and antimony. Although these metals can hardly be replaced by artificial substances, yet there is the possibility of substituting for a metal or its alloy an alloy made from other metals. Perhaps such combinations may be discovered among the metals with which the country is well supplied, particularly one which could be a substitute for copper and its compounds. Bronze, an alloy of copper, tin and zinc, could probably be replaced by steel without much difficulty. Long before the present lack of copper was felt, bronze was supplanted by steel in the building of machinery and the casting of cannon. The substitution of steel for alloys of copper would be advantageous not merely for the present state of war, but also for the future, for Germany has a superabundance of steel or iron, from which it can be made, while copper is a costly import. So here is an opportunity for the inventive

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57 Prizes for Boys

In Si-monds' 1000 Things Made of Wood Contest

First prize, $30 cabinet of carpenters' tools; second prize, a handy kit of saws; third prize, a 24" hand saw; fourth prize, a coping saw; and 150 honorable mentions; for the boys who either at home or in school can make during the next two months with carpenters' tools the most useful or ingenious thing.

The principal material must be wood. String, cloth, metal, etc., may be used only in the smaller details, such as handles, hinges and other trimmings. Objects in any of the following classes will be entitled to compete: porch furniture, kitchen furnishings, library furnishings, bedroom furnishings, business office furnishings, real boats and canoes, camp equipment, other useful objects, things useful in outdoor games, things for the wild birds, things for indoor pets, things for domestic animals, things for poultry, things useful in the garden, things useful in winter, doll furniture, playthings for little children, toy boats, toys with wheels, hobby horses, things useful in entertainments, gymnasium equipment, chemical and physical apparatus, electrical devices.

We offer the three series of prizes in order to interest boys in learning how to use tools, as well as to increase an interest in manual training all over the country. We believe that the salvation of the country depends to a large degree upon the ability of its citizens not only to work with their brains, but to work with their hands, and the purpose of this contest is to stimulate an interest in the proper use of tools, to reward those who show originality in making useful things, and to further the growth and development of the manual training school.

In order that the contest may be open to all, there are three divisions. One for boys who attend manual training, industrial, technical, or trade schools of high school grade or higher; another for boys who are in the elementary grades under special teaching or supervision; and a third set of prizes for boys not in school, but working at home or elsewhere without the aid of a teacher. Special prizes will be awarded to the supervisors whose boys take the greatest number of prizes.

All who desire to compete should send to the Simonds Manufacturing Company for free specification labels which must accompany all work submitted. Only photographs, perspective sketches or complete sets of working drawings should be sent. Address, Dept. No. 9.

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ability that can bring about an undetrimental change of material. The scarcity of aluminium can probably be relieved by improved processes of gaining it, for there is an abundance of clay from which it is derived. Tin, that is largely used for packing boxes, cans, etc., can in some of its forms, as in tinfoil, be replaced by other kinds of wrappers, such as suitably prepared paper. It is very probable that some other process than that of tinning could be used in many cases.

One of the most severely felt losses is that of the import of petroleum. As far as its use in lighting is concerned, skill and energy can easily remove the difficulty. It can be replaced as an illuminant by gas, electricity, alcohol, benzol, and acetylene. For people of small means alcohol and benzol would be the best substitutes, as no costly installation is required, but merely the procuring of new burners for the lamps once used for petroleum, or the purchase of special alcohol or benzol lamps. There is the difficulty that a perfectly safe benzol lamp has not yet been produced; this offers another field to invention.

Alcohol and the coal-tar products benzol and naphthalene will also have to be used as substitutes for the rapidly vanishing benzine in driving motor-wagons. Here, fortunately, no great difficulty will arise, the only change needed being to replace the benzine carbureter by one for alcohol. Alcohol carbureters exist but could be much improved, especially as regards the vaporizing of the alcohol, for, in particular, the machines have still to be started by benzine or benzol. Another needed invention is some method to prevent the freezing of alcohol in winter, perhaps by adding a suitable ingredient which would not affect the force of the driving power.

Alcohol is much used by the German soldiers in a solid form, which is generally a mixture of alcohol and soap. It suffers from the large amount of the non-heating substance, soap. It is greatly to be desired that some inventor should bring alcohol into a solid form without loss of heating-power. It may also be possible to give benzol a solid form. Naphthalene in its usual form is a solid; perhaps it can be brought to a condition where it may replace the solid alcohol.

Any inventions which lead to new uses of alcohol would be advantageous and profitable, as they would increase the sale of the large quantity of alcohol made in Germany and benefit industry. At the present moment such inventions would receive the encouragement of the authorities and associations. There is also a lack of the substances needed by tanners, and artificial syntheses are sought to replace them, but so far without success. Perhaps the mineral method of tanning, which so far has not been successful, may be sufficiently improved to meet the requirements. Or a tanning process may be found in which means not yet tried may be employed.

Another need is a chemico-synthetic process of making albumen and fat, or if there is little prospect of this, at least the production of substances that can replace albumen and fat in various particulars, as albumen in feed for animals, fat and oil in the lubricating of machinery. These problems are indeed difficult, but their solution would be of great importance. For, owing to the stopping of imports, there is a deficiency of albuminous substances for the nutrition of human beings and animals.

Sugar is largely manufactured in Germany and contains much nourishment. It might replace the fats, as butter and lard, if it could be so changed or so combined with other nutriments that a new article of food should appear, better suited than pure sugar for nutritive use. It ought not to be very difficult to replace wheat-flour by a baked mixture of rye-flour, sugar, and perhaps a few other ingredients which would not only be nutritious for the civil population, but would also be welcomed by the German soldiers, who now spread sugar on their dry ration of bread.

There are already artificial substitutes

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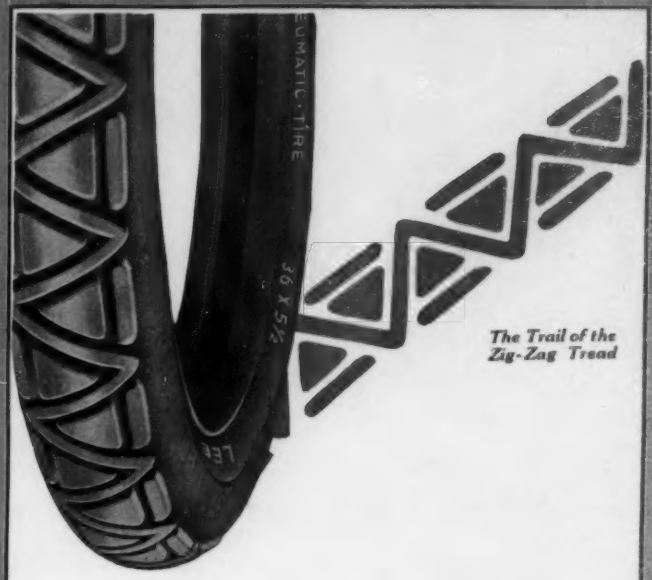

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AN AUTHORITY'S OPINION OF KEWANEE SMOKELESS BOILERS

CLAUSEN & KRUSE
ARCHITECTS
April 29, 1915.

Kewanee Boiler Company,
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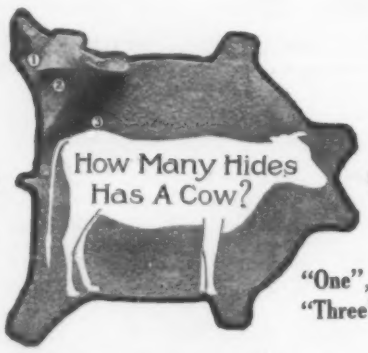

"One", says Nature
"Three", says Cunning

Because demand far exceeds supply, man craftily splits each cowhide into several sheets. But—there can be only *one* sheet of grain leather. The rest are merely "splits"—coated and grained to *look* like the genuine article, and sold as "genuine leather", but they do not wear like hand or machine buffed leather. Right here enters

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for various natural products which are at present scarce in Germany. The points to be considered by inventors in regard to these are the perfecting and cheapening of the processes of artificial production. Thus, artificial rubber is already known, and what is now needed is to perfect and build up its industrial manufacture, so that the synthetic product can compete in cheapness and good qualities with the natural one. In some respects artificial camphor is even superior to natural camphor, but its manufacture needs to be made less costly, and some substitute ought to be found among the substances natural to Germany to take the place of the imported turpentine oil used in making it. The nitrate of soda imported from Chile has already been replaced to some degree by nitrogen obtained from the air or by the ammonia won in the coking of hard coal. The trouble here is that the processes for gaining atmospheric nitrogen are still too costly, so that the nitrogen thus gained and used in artificial fertilizers is not yet able to supersede the Chile nitrate. Moreover, the nitrate from Chile seems better suited to the fertilizing of certain plants, as the sugar-beet. In addition to cheapening the processes of winning atmospheric nitrogen, it is also necessary to improve the artificial fertilizers, above all to make them more soluble.

If successful substitutes could be found for all or even part of the imported natural products mentioned, there would be a great saving of the profits now going to other nations and an increased stimulation of German industries. The amounts paid by Germany in 1912 for these products of other countries were:

	Million Marks
Cotton and cotton fabrics	792
Wool and woollen fabrics	665
Jute and tow	75
Hemp and flax	187
Silk and silk fabrics	228
Petroleum	63
Other oils and fats	155
Rubber and rubber goods	207
Chile nitrate	179
Camphor	28
Turpentine oil	19

The total value of these articles amounts to about one fourth of the entire German imports.

The writer considers that home productions in the place of these imports would have the advantage of making Germany independent of the outside world, so that no enemy could reckon on overcoming the country by cutting it off from communication with the rest of the globe. "Perhaps instead," he continues, "foreign countries, including England, might be made dependent on Germany to such degree by the indicated development that an embargo on intercourse with Germany would be dangerous to every other country. If German industry were able to gain a monopoly in the artificial manufacture of rubber, nitrogenous fertilizers, spun thread, or even albuminous substances, similar to that which it has in the manufacture of aniline dyes, medicinal preparations, and surgical instruments, a sudden check which Germany could ordain in the supply of all or even one of these articles might be disastrous for every country affected, and each land would have an increased fear of war with Germany."

In the same way, the writer thinks, Germany might be able to do great damage to England if it could by artificially produced manufactures cripple the British rubber and jute industry in India and its cotton industry in Egypt, just as German applied science has injured the English dye-trade and at one time broke down the Anglo-Indian indigo trade. His conclusion is that German invention and manufactures have never had such an opportunity as the present offers, when both economic and political conditions offer a speedy and great reward to successful labor in the indicated directions.

Strategic Moves of the War

(*Concluded from page 198.*)

the balance of the army. The same fate appears to be threatening Bialystok and Brest-Litovsk, the principal supporting points on the Russian second line of de-

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fense which they had hoped to hold after abandoning the Polish salient. Vilna, on the Petrograd railway, is seriously threatened, and Dvinsk, farther north on the same railway, is in danger. A slight additional advance of the German left will deprive the Russians of this important line of supply, and the capture of Kovel would take from her still another.

It has taken the Teutons four months to fight this campaign to its present point, pushing backward first one portion of the Russian line and then another, and their entire gain along the whole front is less than two hundred miles. What better illustration could be had of the tremendous resisting power of an army which numbers millions and extends on a front of many hundreds of miles? In the same length of time the smaller armies of former wars under similar conditions probably would have been exterminated. The long campaign has been marked by frequent pauses for shifting the Teuton reserves behind their advanced fighting lines and otherwise making ready for the next move forward. These appear to have increased in length as the campaign has progressed, due partly to greater supply difficulties, and partly, no doubt, to exhaustion of the Teuton armies. There is reason to expect that the further progress of the invaders will be less rapid unless the resisting power of the Russians has been reduced more than we think. The Teutons are approaching the vast marshlands of the Pripet River, so impracticable for military operations as to greatly increase the difficulties of their further advance; and their attempts to secure the Gulf of Riga by combined land and naval operations have failed.

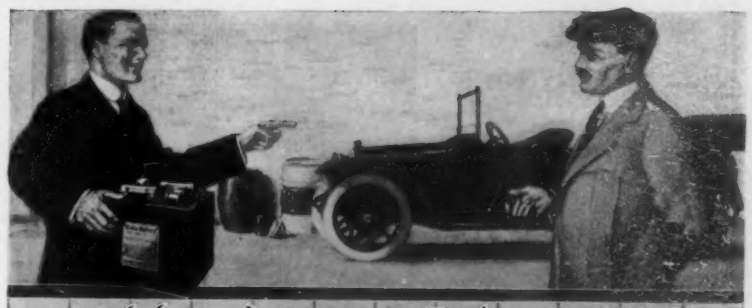
The invaders are still making progress, but they are still confronted by a united opponent whose *morale* probably has not suffered dangerously on account of his long retreat, because this formed an essential part of Russian strategy. The Russians have made the Teuton pay dearly for all he has taken and have succeeded in withholding the great prize for which he is struggling—the destruction of their army. Behind them lies the vastness of Russia, and their past performances indicate that they may succeed in continuing to elude the invader until somewhere and sometime an equilibrium of forces will be established and they will be able to take the offensive. But this great struggle has shown more clearly than has ever before been seen that modern warfare is waged not only by the forces in the field, but by the great industrial and financial forces at home as well, and these may shape the final decision before the point can be reached at which the Russian armies are superior to the opposing Teutons.

The Bee in Winter Time

PHYSICALLY, the bee perches upon one of the lower branches of the genealogical tree of the animal kingdom, but he certainly performs some stunts which raise considerable doubt as to where he should be classed mentally. When we stand shivering with the cold on the street corner waiting for the belated car we stamp our feet, swing our arms and snap our fingers to keep warm. And what does the bee do when he is shivering with the cold? Precisely what his more highly civilized relations do.

If any of us had been permitted to assist in an investigation which the United States Department of Agriculture has been carrying on we would realize that the bee upholds his reputation for industry throughout the winter months as well as during the summer. Being susceptible to cold and yet neither able to put on a fur coat and mittens nor sit by a roaring fire when the thermometer begins to fall the bee must turn to his colony for warmth. Communism, which in bees is so highly developed in the storing of food and caring for the young, is also the basis for the heating system.

It was found at Philadelphia, where the experiments were carried on in hives provided with glass sides, that only the shell of the cluster made by the bees in cold weather is compact. This is formed



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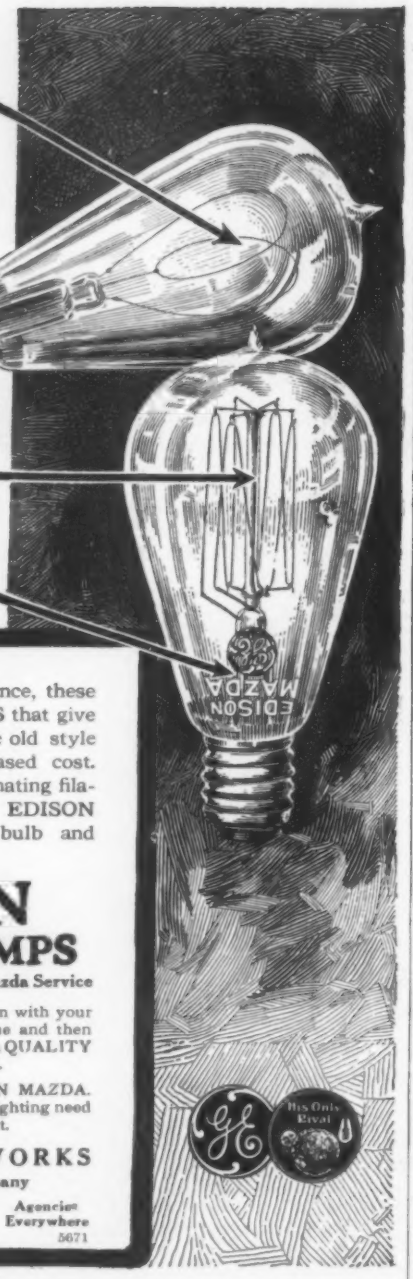

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by one to several layers of bees all solidly arranged with their heads inward, their hairs interlacing. This arrangement is perfect for conservation of the heat within. Except for an occasional shifting of position the bees forming the shell are quiet.

But within the shell strange things are going on. It is here that the heat is generated. And the antics are not unlike our own when we are cold. The bees are packed loosely within the shell so that there is plenty of space for many bees to be exercising at a time. Rapid fanning of the wings, shaking the body from side to side, rapid breathing and other movements are all part of the scheme for raising the temperature. In one particular instance, when a bee had been rapidly fanning with his wings for 7½ minutes the thermometer nearest him rose ½ deg. Fahr.

It is remarkable what a high temperature is produced by the bees under these conditions. Ordinarily it is a very difficult thing to take temperature records of a colony of bees, for they are so susceptible to any disturbance, but in these experiments an electrical device was used whereby records were obtained without the hive being disturbed. It was found that whenever the outside temperature fell below a certain point (57 deg. Fahr.) the temperature within the cluster began to rise and fluctuated upward and downward according to the change in temperature without. On November 15th, at 6 P. M., the outdoor temperature was 47 deg. Fahr., the temperature of the cluster 59 deg. Fahr. The following morning at 6 o'clock the outdoor temperature had dropped to 39 deg. Fahr. and the temperature within the cluster risen to 89 deg. Fahr.

So perfect an insulator of heat is the shell formed by the bees with the interlaced hairs that the difference in temperature recorded by two thermometers, one at the center of the cluster and one just outside the cluster, the two being only 4½ inches apart, was 75 deg. Fahr.

Safety in Coal Mines

IN addition to certain technical considerations and suggestions contained in its recent bulletin by George S. Rice and L. M. Jones the Bureau of Mines puts the responsibility for mine explosions largely upon the mine operators and employees. The bulletin states that "explosions can no longer be considered 'acts of God,' for which no one is responsible." It points out that the adoption of preventive means is largely in the hands of mine operators, but in carrying them out every mine employee is concerned, particularly in gaseous mines or those in which inflammable gas is sometimes encountered. It has been determined that without open flame of some sort there would be no explosions; that since the inauguration of the bureau's work in 1908 only a single explosion disaster has occurred in a mine in which safety lamps were being used prior to the explosion. Much of the bulletin is devoted to rock dust and barriers as a supplementary means of stopping explosions that have started in spite of precautionary measures, the use of these barriers being largely due to the influence of J. Taffanel the distinguished director of the French mine-testing station at Liévin, who, in a month's visit, greatly stimulated the explosion experiments in collaboration with the bureau's representatives at the experimental mine at Bruceton, Pa. The bulletin is interesting and contains much important information for the consideration and information of mine operators and employees as well.

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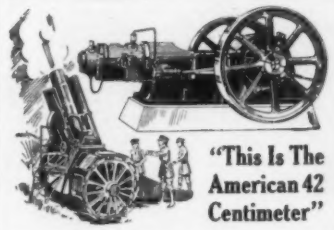

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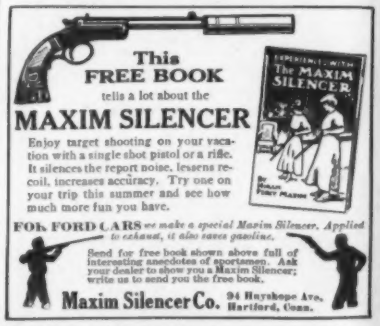

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Cartridges for War

By Edward C. Crossman

PROBABLY the greatest example of wastefulness in war is the metallic cartridge case. It is useful chiefly as a box to hold bullet, powder and primer together in loading the rifle or field gun, and to seal gas-tight the breech of the gun. That it is not essential to this sealing is proved by the fact that big guns do not use metallic cartridge cases.

In the United States service, the case for the military rifle cartridge costs 1.2 cents to make. So excellent is its quality that it can be reloaded twenty times without showing a split in its structure or losing its taper, necessary to allow it to be extracted from the barrel of the rifle.

The Germans alone must have fired up to the present writing more than a billion rounds of infantry charges. This allows but a thousand rounds each for a million men for a year of fighting, and not a round for the machine guns, the most greedy users of ammunition of all the service weapons. Save in exceptional instances, the empty cases cannot be saved. The bill for a billion empty cases amounts to the comforting little figure of $10,000,000. Worse than this, in Germany's case it means the loss of the cheerful figure of some 30,000,000 pounds of copper and zinc, otherwise brass.

As it was in the beginning, there was no cartridge case. From the coming of the powder gun in the fourteenth century until the middle of the nineteenth century the cartridge case was an unknown luxury. Through match lock and wheel lock and flint lock and percussion lock, the powder and the bullet, and the means of firing the charge, were happily separate. Could your army but get a few barrels of powder and a few pigs of lead, it asked no more. Bullets were easily evolved with the simple molds in use. For long years our frontiersmen bought their ammunition "on the hoof," the powder in the keg, the bullets in the pig of lead.

Then in the fifties came the marvelous discovery that, if the bullet and the powder were united in an easily broken tube of paper, all the fussing with separate bullet and powder flask disappeared. Yarn—possibly history—says that the Indian mutiny came partly because the Indian troops were obliged to bite off the end of the paper cartridges used in their muskets, and said cartridges were lubricated with cow's fat, which was as a barred gate to the Hindoo heaven.

The biting process was necessary to free the powder and make it accessible to the flash of the percussion cap perched on the nipple on the outside of the rifle. One of the necessities for the soldier was a good set of front teeth for this chewing process.

With such crude tools was the civil war fought.

Improvement in rifle and cartridge has been most marvelously slow in a time when ships changed from the caravels of Columbus to the "Lusitanias" of the Cunards, from the hand printing press of Elizabeth to the high-speed presses that turn out bushels of Sunday papers. Save for the rifling in the barrel, and the use of the percussion cap in place of the flint lock—the latter bitterly opposed even at the time of the Mexican war by army mossbacks—the rifle of Gettysburg was the musket of Bunker Hill. Even Bunker Hill knew rifles in the hands of some of the Americans, instead of the smooth tubes of the British soldiers.

About the time of the civil war came the first attempts at the breech-loading rifle, our Sharps. It used the old paper cartridge, and "obturation," the sealing of the breech, was poor. So it came about that fireworks resulted from each shot, the flash from the breech being enough to burn a handkerchief. Four hundred years of powder rifles had not produced a car-

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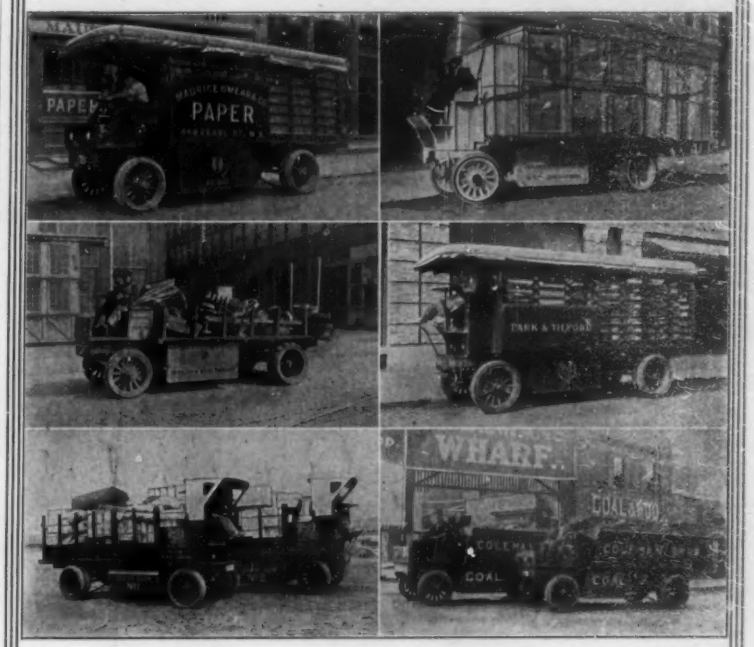

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Make This Novel Test

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tridge capable of breech sealing, or a practical breech-loader.

The French and the Prussians argued out the question in 1871 with early breech-loaders, the Chassepot of the French, the needle gun of the Germans. Both used the paper cartridge in the early days of the war, and great was the grief therefrom. Both rifles drove a needle—the firing pin of the modern rifle—into a primer or cap inside the paper case, in the German rifle set on the base of the bullet itself. Having to drive clear through the powder charge, which immediately took fire and burned with the needle still in it, the needle speedily burned or broke off, and the soldier then had a very good club, or spear if he fixed the bayonet.

To do what the early paper case did imperfectly, but still with some fatalities to its credit, the perfect and costly brass cartridge case is now used. It holds powder, bullet and primer, and it closes the imperfect joint of breech bolt and barrel.

It starts with a sheet of brass of the proper mixture for the results desired. Round disks are punched out of it, the size of a 25-cent piece. Then they are introduced to a draw press, which is equipped with a die and a punch, and the disks are persuaded into the form of a shallow cup with sharply upturned edges. From this to the final case is a series of drawings on these presses. As drawing tempers brass, and as the case speedily would become brittle, it is annealed—heated in a furnace and allowed to cool—between each drawing operation.

The final case is not merely a brass case; it is a brass case with precisely the right temper to do the work required of it. It is tempered as carefully as a bayonet in the final processes. If the case is soft, it would stick to the chamber of the rifle, and refuse to extract. If it is hard and brittle it breaks off in the chamber and disables the rifle. The pressure in the chamber of the German Mauser is 55,000 pounds per square inch of chamber area. This has a tendency to drive the thin walls of the brass case out into every minute roughness of the chamber, and if the case then does not spring loose from the chamber when the powder pressure is off, no extractor is going to drag it from its death grip.

In the American service the empty cases are picked up and turned in. Because of the bad habit of empty cases in getting into incidental bonfires on rifle ranges, a test is arranged at the arsenals for slips from virtue. A case that has been in a bonfire is not the case again to reload and put into the service rifle, because it is then annealed, soft and likely to refuse to extract.

So an inclined steel plate with a little fence in front of it is placed where the cases must fall, and they are dropped on it, base first, from a considerable height. The tempered and virtuous ones bounce and jump the fence to the pew of the anointed. The soft cases that have been in the fire cannot get up enough bounce to clear the fence, and so fall into the pen of the condemned, to be used for blank or guard cartridges. This is, of course, the sceleroscope with a reverse English.

Incidentally the cases made by the United States arsenals are the finest in the world, not equaled by those of any other nation, or of any private maker.

A grave obstacle to reloading the German case is the fact that it has no way easy to decap. The American case has a central flash hole in the case which leads the primer flame to the powder, and which serves to admit the point of a decapping punch when the case is to be reloaded. The German and other foreign case is not so made; two tiny pin-prick style of holes lead from primer pocket to powder chamber, and of course effectually block the passage of a punch to drive out the old primer. Only by a gouge operating from the outside, or by hydraulic pressure of the case full of water, and a rammer to force it through the tiny flash holes, can the old primer be removed.

In time of peace or in ordinary wartime need this is not serious, but when copper is contraband and scarce, and the consumption of ammunition beyond the

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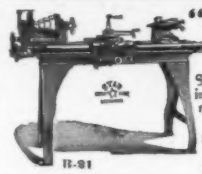

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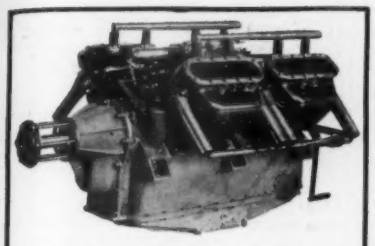

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How the War Has Modified the Aeroplane

(*Concluded from page 197.*)

the number of German machines and their crews destroyed or captured during the first four months of the war. This record reads as follows:

August	15 machines	32 airmen
September	15 machines	23 airmen
October	12 machines	24 airmen
November	25 machines	52 airmen
Total	67 machines	131 airmen

Eighty per cent of these craft were accounted for by French and Belgian pushers of the types above described, while the rest were winged by British tractors and French monoplanes through rifle fire.

While this record is an eloquent testimonial of the efficiency of French fighting aeroplanes during the first few months of the war, a considerable change in aerial operations occurred as soon as the Germans began to use the powerful 150 horse-power Benz and Rapp motored tractors, which had been either held in reserve or building at the outbreak of the war. Whereas the 80 horse-power Farman and Voisin pushers have a speed of about 65 miles per hour, this proved insufficient for rounding up the very fast new German tractors mounting machine guns which began to show above the Allies' lines in November last. Against these the French pushers found themselves in a dangerous state of inferiority; while the Germans had the greater climbing speed, the Frenchmen were both too slow to overtake them and too slow to run away when attacked by superior numbers.

Nevertheless these defects were soon afterward remedied in the new machines the French Aviation Corps put into commission in 1915, in which more speed and life were incorporated. These machines, the 140 horse-power Renault-motored Farman and the 135 horse-power Salmson-motored Voisin pushers, have since proven to be at least the equals of their Teutonic antagonists; for being very fast and having a large cruising radius, they are enabled to carry out long distance reconnaissances into German territory, in the course of which they can easily account for the enemy aeroplanes that should want to stop their progress.

The 135 horse-power Voisin pusher is a particularly interesting type of fighting craft in that it can easily be converted into a bombardier. When used as a fighting unit the machine is fitted with a machine gun that is mounted on a tripod fixed between the seats of the pilot and the gunner; thanks to this arrangement the gunner, who works the gun standing with his back against the cellule, is both afforded a fairly comfortable position in action and a very wide arc of fire, both laterally and vertically.

When employed as a bombardier, the machine gun's place is taken by a bomb dropping device that was invented by Col. Espitallier of the French Army Engineers. How well this device works is shown by the destruction wrought at Carlsruhe, where 130 bombs were dropped, killing eighty-nine people and wrecking the Grand Ducal palace, a railway station and an arms factory. In fact, every important French air raid into Germany is to the credit of Voisin bombing squadrons (Freiburg, Muelheim, Leopoldshoehe, Ludwigshafen, Carlsruhe, Colmar); these raids are generally carried out in concert by bombing and fighting aeroplanes, the latter being given the task of tackling the enemy aircraft while the bombardiers discharge their bombs.

The bombs employed by the French Air Service are of three types: the largest one weighs 220 pounds, but is used only very seldom, the two current types being the 22-pound bomb of 90-millimeter caliber and the 92-pound bomb of 155-millimeter caliber. The latter is five and one half feet long and is fitted with stabilizing fins that make it look like a torpedo.

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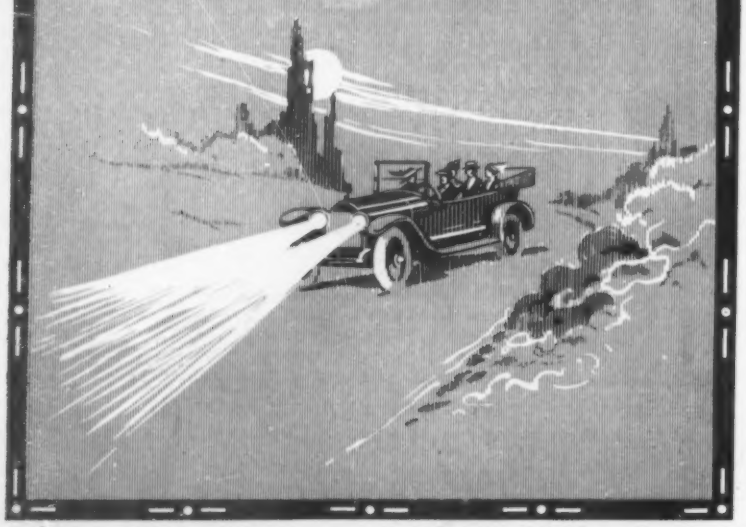

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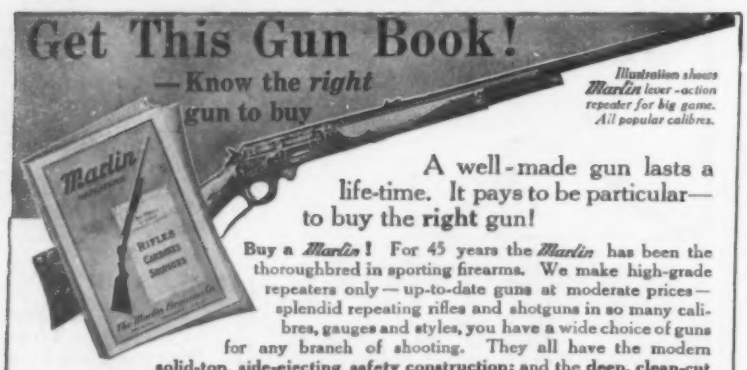

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given an excellent account of itself whenever it was employed, the French Air Service did not stop to consider it as embodying ideal features and has urged aeroplane manufacturers to produce a still more powerful fighting craft, so powerful, indeed, that it would knock out anything else aloft. The specifications called for a fast-climbing machine of large cruising radius, that would carry a small quick-firer and be armor-plated. While tremendous odds confronted the realization of this programme, one French aircraft manufacturer has now succeeded in producing a type of machine that well responds to the given requirements.

This machine, an all-steel pusher biplane, is driven by a 200 horse-power engine that develops a top speed of 85 miles per hour; it carries a crew of four and mounts a 6-pounder throwing a high explosive projectile. A light armor belt fitted around the nacelle protects both the crew and the engine against rifle fire from a very close range. This machine, the first one that really deserves the name of battle aeroplane, marks an enormous advance over the former types of fighting aircraft employed by the French, which mounted only a machine gun. Being very fast and a quick climber it can easily overtake any other fighting aeroplane and promptly destroy it with its 6-pounder, whose shells, filled with a high explosive, are obviously much more effective than the steel capped bullets thrown by a machine gun. On the other hand this battle aeroplane seems to be practically invulnerable against the speed scouts developing 100 miles per hour, whose pilots are equipped only with automatics, against which the armor-clad nacelle affords sufficient protection, while the 15 miles difference in speed is more than counterbalanced by superior armament.

While the French Air Service was thus developing fighting aeroplanes which could be converted into bombardiers and was bent upon conciliating specialization with standardization, Germany found herself in a peculiar position on account of a principle carried too far.

Since 1912 all her military aeroplanes had been standardized, with a view of forming homogeneous squadrons into two types, both tractors: the Taube monoplane and the Arrow type biplane, which were expected to effect all the services the French had specialized different machines for: scouting, fighting, bombing, and gun-spotting; on the other hand the construction of pushers was persistently discouraged. The result of this somewhat excessive zeal in favor of standardization was, that while it proved excellent in view of facility of construction and the building up of large stocks of spare parts, it precluded adaptability to the quick and often radical changes war created in the design of military aeroplanes.

When this mistake was realized by the German Air Service, the Great War was in full swing and much valuable time had been lost before initial errors could be remedied. But even then Germany only reluctantly admitted the superiority of the pusher as a fighting machine; it is true two or three companies are now building exact copies of the Farman and Voisin pushers that have fallen within the German lines, but most Teutonic aeroplane manufacturers are still clinging to the type of standard tractors they have been building since 1912, although they have lately been fitted with much more powerful engines (150-200 horse-power Argus, Benz, Rapp, and Mercedes) than heretofore. The new machines generally mount two machine guns, one in front just behind the pilot and the other aft on the fuselage, the pilot sitting between the two gunners. They climb exceedingly well; indeed the only French aeroplane that has so far been able to out-climb them is the Morane-Saulnier "avion de chasse," a single-seater monoplane armed with a machine gun which is fitted with a timing device, and permits firing into the propeller.

Although little is known about the present activity of German aircraft plants, certain signs indicate that large machines fitted with independent power plants are also in course of construction in the Kaiser's empire. The first intimation regarding this fact was given by the official eye-witness with the British army in France in a report describing a combat of a British airman with a huge German biplane that had a double fuselage, two engines and a pair of propellers, and which was fast enough to circle around the Briton.

Following this report comes now the news that Germany is shortly going to put in the air a fighting triplane, which is expected to overcome anything else that flies. The new machine, it is said, will have three planes and be powerful enough to carry twenty men, four machine guns and an aircraft gun of 47 millimeters. It will be equipped with eight Maybach engines of 180 horse-power each, such as are used to propel the Zeppelin airships, the engines being coupled together in pairs, each couple driving one set of propellers. The revolver gun will be mounted in an armored turret, while the entire underbody of the machine will be armor-plated and shaped like an inverted roof in order to avoid anti-aircraft projectiles from below.

All the steering, with the exception of changes of altitude, will be executed with the aid of the engines; turns will be effected by inclining the propellers. Two engines will be sufficient to propel the machine in the air and an extraordinary speed is expected when all the engines will be running.

While France and Germany are draining every one of their aircraft plants to the utmost in order to make them produce as large a number of battle aeroplanes as is materially feasible—for which the number of pilots available comes foremost into consideration—the other aerial powers are not remaining idle either.

Italy, following closely the lead of other aerial powers, has lately developed an original type of fighting scout that is the invention of Signor Caproni, the well-known aircraft manufacturer. This machine presents an interesting solution of the large aeroplane in that it combines the pusher and tractor types and can easily be converted into a sea-going craft. There are two fuselages, placed side by side between the planes, each complete with its engine and tractor screw, and a central nacelle that houses a third engine driving a pusher screw. The power plant consists of three 150 horse-power Isotta-Fraschini engines. The nacelle projects well forward in front of the tractor screws and affords thereby a wide arc of fire to the aircraft gun that is mounted on its bow. The useful load carried by this machine amounts to one ton, which is made up by a crew of two (pilot and gunner), fuel tanks for eight hours flight, a 25-millimeter aircraft gun and ammunition.

As can be seen by the appended table, the development of the battle aeroplane is by no means limited to one or two countries only; in fact, an aerial construction race seems to have just started among the Great Powers, each endeavoring to build the most powerful "big-lift-and-speed" aeroplane. Although this movement is still in an embryonic state, it is easy to picture what proportions it will take in the near future, when the aeroplane will have become a real battle-cruiser of the air.

TABLE SHOWING ARMAMENT, SPEED AND CRUISING RADIUS OF THE FIVE PRINCIPAL EUROPEAN FIGHTING AEROPLANES. (NO DATA ARE AVAILABLE REGARDING THE THICKNESS OF ARMOR BELT CARRIED.)

Country.	Armament.	Speed (Miles Per Hour).	Cruising Radius (Hours).	Type.
France	One 6-pounder.	85	?	Pusher-biplane.
Great Britain	One 1½-pounder (42 mm.)	75	12	Flying-boat.
Germany	One 3-pounder (47 mm.). Four machine guns.	?	?	Triplane.
Russia	Two machine guns.	65	6	Tractor-biplane.
Italy	One ¾-pounder (25 mm.)	75	10	Tractor-pusher.

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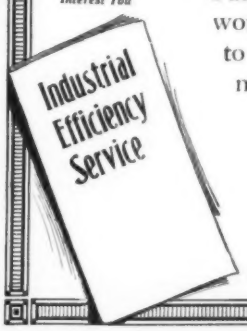

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Don't follow wasteful, expensive and tedious methods—remember that "wherever two pieces of metal are to be joined, you will find a profitable use for Prest-O-Lite Oxy-Acetylene Welding." Investigate the savings you can make in metal manufacturing, construction and repair work. Other manufacturers, garage and shop owners are getting the benefits in economy, efficiency and quality that only this process can give. Are you?

Cost of equipment needed is low. Operation is simple, and easily learned. Often just one repair, made "on the spot," more than pays for all necessary apparatus.

We furnish a thoroughly high grade welding apparatus for $60.00, not including acetylene cylinders which are extra and are furnished under a liberal service plan. Truck and special cutting equipment at extra cost.

Process in Easy Reach Through

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Dissolved Acetylene

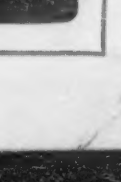
(Ready-made Carbide Gas)

Prest-O-Lite Acetylene Service is permanent and universal, furnishes the highest grade of Dissolved Acetylene in portable cylinders and is used as conveniently as you use cylinders of oxygen. Saves the large initial outlay and heavy depreciation, trouble and inconvenience of making crude Acetylene in carbide generators. Besides, Prest-O-Lite Dissolved Acetylene is perfectly dried, cleaned and purified—makes better welds and is cheaper to use.

If you use Acetylene for ANY purpose, you should have full details of this unparalleled service.

Start Now—Get Full Details

Send for literature that shows what you can do in your shop, the savings you can make. Your name and address on the margin of this page will bring it to you.



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